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Mark Scheme (Results)

Summer 2015

Pearson Edexcel GCE
in 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.

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.

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:

'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:

$80 \text{ cm} \times 50 \text{ cm} \times 1.8 \text{ cm} = 7200 \text{ cm}^3$

$7200 \text{ cm}^3 \times 0.70 \text{ g cm}^{-3} = 5040 \text{ g}$

$5040 \times 10^{-3} \text{ kg} \times 9.81 \text{ N/kg}$

$= 49.4 \text{ N}$

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.

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

Question Number	Answer	Mark
11	Viscosity is lower at higher/room temperature **(1)** (Butter at a higher temperature:) requires less force/friction/resistance (to spread) **Or** less work needs to be done (to spread the butter) **(1)** (Accept converse answer for MP1 and MP2)	**2**
	Total for question 11	**2**

Question Number	Answer	Mark
12(a)	The balloon has the maximum/great**est** speed/velocity **Or** the great**est** distance is covered in the shortest/same time **(1)**	**1**
12(b)	Use of $\Delta E_{grav} = mg\Delta h$ (with a Δh and not just h) **(1)** Use of average rate of energy transfer = $\frac{\text{energy}}{0.15\text{ s}}$ **(1)** (do not penalise power of ten errors for MP2) Average rate of energy transfer = 0.18 – 0.19(W) **(1)** <u>Example of calculation</u> $\Delta E_{grav} = 0.004\text{ kg} \times 9.81\text{ N kg}^{-1} \times (1.8\text{ m} - 1.1\text{ m}) = 0.027\text{ J}$ Average rate of energy transfer = $\frac{0.027\text{ J}}{0.15\text{ s}} = 0.18\text{ W}$	**3**
	Total for question 12	**4**

Question Number	Answer		Mark
13(a)	Force × distance moved in the <u>direction</u> of the (applied) force (An equation with defined terms and the direction stated of the distance can score this mark)	**(1)**	**1**
13(b)	Use of KE = ½mv^2 (with any velocity in m s^{-1}) Use of Work done = Fd (with any energy) d= 85 m **Or** Use of $F = ma$ to find the acceleration Use of suitable equation(s) of motion to find the braking distance d= 85 m <u>Example of calculation</u> KE_{before} = ½ × 1.5 × 10^3 kg × (24.6 m $s^{-1})^2$ = 4.54 × 10^5 J KE_{after} = ½ × 1.5 × 10^3 kg × (13.4 m $s^{-1})^2$ = 1.35 × 10^5 J Transfer of KE = 4.54 × 10^5 J − 1.35 × 10^5 J = 3.19 × 10^5 J 3.19 × 10^5 J = 3750 N × d d = 85.1 m	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**3**
	Total for question 13		**4**

Question Number	Answer		Mark
14(a)	This is describing weight/force and not the mass **Or** the newton is not the unit of mass **Or** mass does not have a direction **Or** kg is the unit of mass and not force/weight The velocity should be speed **Or** velocity would need a direction The car would be decelerating **Or** the car should be speeding up (for an acceleration) **Or** a direction is needed **Or** the value should be negative/-2.5 m s^{-2}	**(1)** **(1)** **(1)**	**3**
14(b)(i)	Distance = 75 km	**(1)**	**1**
14(b)(ii)	Use of Pythagoras **Or** correctly constructed scale drawing (labels not required) Displacement = 54 km Direction = 34° East of North (accept angle indicated on diagram) (there is only 1 unit error for km in (i)and (ii)) <u>Example of calculation</u> $Displacement^2 = 45^2 + 30^2$ Displacement = $\sqrt{2925}$ km Displacement = 54.1 km Direction = 33.7° (east of north) **Or** 56° (north of east)	**(1)** **(1)** **(1)**	**3**
	Total for question 14		**7**

Question Number	Answer	Mark
15(a)(i)	Use of $W = mg$ **(1)** Use of $T\cos30$ **Or** $W/\cos30$ **Or** $T\sin60$ **Or** $W/\sin60$ **(1)** Factor of 4 seen/used **(1)** $T = 1.5\times 10^{-3}$ N **(1)** <u>Example of calculation</u> Weight $=5.4 \times 10^{-4}$ kg $\times$ 9.81 N kg^{-1} = 5.30×10^{-3} N Vertical component of tension = $T\cos 30°$ $4T\cos 30° = 5.30 \times 10^{-3}$ N $T = 1.53 \times 10^{-3}$ N	**4**
15(a)(ii)	The tension has a horizontal <u>component</u> (as well) **Or** only the vertical <u>component</u> of the tension supports the weight **(1)**	**1**
15(b)	When under the twig (the stress/force is) tensile and when on top it is compressive **(1)**	**1**
	Total for question 15	**6**

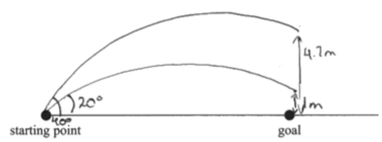
Question Number	Answer	Mark
16(a)(i)	The increase in extension is constant for a fixed increase in mass **Or** mass is proportional to extension **Or** extension is proportional to mass **Or** graph is a rising/increasing straight line **(1)** The wire obeys Hooke's law **(1)**	**2**
16(a)(ii)	Use of area under the graph **Or** use of ½ $F\Delta x$ (with m or F) **(1)** Identify that the limit of proportionality is at 2.6 ± 0.1 kg **(1)** Elastic potential energy = 0.5 J **(1)** (accept 0.40 J to 0.50 J) Example of calculation Area under the graph = ½ × 3.5×10^{-2} m × 2.6 kg = 0.046 kg m Area × g = 0.046 kg m × 9.81 N kg^{-1} Elastic potential energy = 0.45 J	**3**
16(a)(iii)	The wire will experience a large (increase in) extension/strain for a small (increase in applied) force/stress/mass **(1)** The wire will not return to its original length/shape (once the force is removed) **Or** the wire will be permanently deformed **Or** the wire will exhibit plastic deformation/behaviour **(1)**	**2**
16(b)(i)	Thinner wire **Or** smaller CSA/ diameter/radius **Or** longer wire **Or** wire with a lower stiffness/k/spring constant **Or** wire that is more ductile **Or** wire with a lower Young modulus **(1)** (comments must be comparative)	**1**
16(b)(ii)	**Max 2** Use a pointer on the wire/masses **(1)** Sensible suggestion to reduce parallax e.g. read at eye level **Or** place the rule as near as possible to the mass/wire **(1)** Use a set square to ensure rule is vertical **(1)** Wait for the extension to finish **(1)** Add masses gently **(1)**	**2**
	Total for question 16	**10**

Question Number	Answer	Mark
17(a)	This can be marked in terms of the train either initially stationary or moving with constant speed. State N1in terms of ΣF =/> 0 e.g. An unbalanced/net/resultant/total/ΣF force of zero gives constant speed/velocity/motion **(1)** (the friction between floor and feet) accelerate the feet **Or** (friction between floor and feet) creates an unbalanced/net/resultant/total force on feet **(1)** the train accelerates but the man continues travelling at the original/constant speed **Or** the top half has no (resultant) force as the train accelerates **Or** the man's speed relative to the train is lower **Or** (All of the) man needs to accelerate at the same rate as the train **(1)**	**3**
***17(b)**	(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate) Man pulls (backward) on the support **(1)** Due to N3 the support exerts a (opposite) force on the man **(1)** This force is a resultant/unbalanced/net force on man **(1)** Due to N1/N2 the man will accelerate **(1)** With the same acceleration/speed/velocity as the train **(1)**	**5**
	Total for question 17	**8**

<table>
<tr><th>Question Number</th><th>Answer</th><th></th><th>Mark</th></tr>
<tr><td>18(a)(i)</td><td>The ball has bounced Or the ball would be below initial height Or the ball has landed before reaching the goal Or the ball has hit the ground</td><td>(1)</td><td>1</td></tr>
<tr><td>18(a)(ii)</td><td>Correct shape of at least one trajectory, starting at the kick and ending at/beyond the goal

Range/position of the higher angle > range/position of lower angle ball seen with paths labelled

Example of response scoring 2 marks


</td><td>(1)

(1)</td><td>2</td></tr>
<tr><td>18(b)(i)</td><td>Use of (u_H) = u cos15 Or u sin75 Or see 25(.1) m s^{-1}
Use of $u = s/t$ to calculate the time to the goal Or see 0.44 s
Use of (u_V) =u sin15 Or u cos75 Or see 6.7 m s^{-1}
Use of $s = ut + ½ at^2$ (a must be negative)
s = 2.0 m

Use of (value obtained + the 0.22 m (or 0.11 m)) to make a sensible statement as to whether or not the goal will be scored
e.g. the top of the ball on reaching the goal 2.23 m. (This is less than 2.4 m and) the goal will be scored

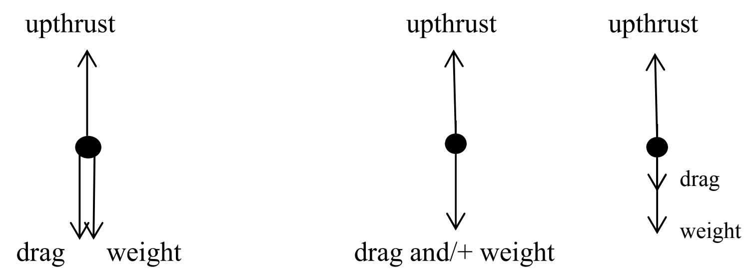
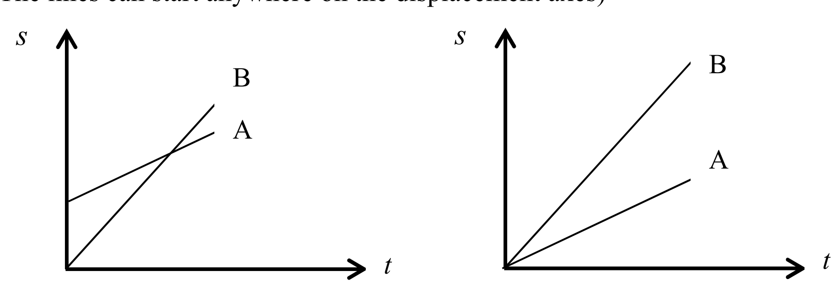
(Answer must be consistent with calculated distance. For calculated heights greater than 2.4 m, candidates do not need to refer to radius /diameter but a comparison of heights is needed.)

<u>Example of calculation</u>
$t = \frac{11\ \text{m}}{26\ \text{ms}^{-1} \times \cos 15°} = 0.44$ s
$s = (26\ \text{m s}^{-1} \times \sin 15°)(0.44\ \text{s}) + (½)(-9.81\ \text{N kg}^{-1})(0.44\ \text{s})^2$
s = 2.01 m
Height of the top of the ball on reaching the goal = 2.01 m + 0.22 m = 2.23 m</td><td>(1)
(1)
(1)
(1)
(1)

(1)</td><td>6</td></tr>
<tr><td>18(b)(ii)</td><td>Air resistance is in the opposite direction to the ball’s motion Or air resistance adds a backwards force Or work is done against air resistance

The ball will decelerate (horizontally) Or the ball will have a decreasing velocity/speed Or the ball will not travel as far Or this reduces the maximum height the ball reaches Or the ball is in the air for less time Or the ball will take longer to reach the goal</td><td>(1)

(1)</td><td>2</td></tr>
<tr><td></td><td>Total for question 18</td><td></td><td>11</td></tr>
</table>

Question Number	Answer	Mark
19(a)(i)	Weight/*W*/*mg* **(1)** Upthrust/*U* **(1)** Drag/Friction/Fluid resistance/*F*/*D*/*V* **(1)** (all lines must touch the black dot and should be approximately vertical by eye) (−1 for each additional force) 	3
*19(a)(ii)	(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate) <u>Upthrust</u> is greater for the larger bubble **(1)** Drag/friction increases **(1)** Upthrust increases more than drag **Or** greater (initial) resultant force on bubble **Or** higher terminal velocity **Or** upthrust is related to volume/radius^3 **and** drag related to area/radius$^{(2)}$ **(1)**	3
19(b)(i)	Both graphs straight from t = 0 (labels not required) **(1)** Initial gradient of A less than gradient of B (minimum of 1 label required) **(1)** (The lines do not have to meet i.e. the lines could stop before the meeting point The lines can start anywhere on the displacement axes) 	2

19(b)(ii)	Measurement from photographs 0.5 - 0.7 (cm) **(1)** Use of distance = measurement × 12 **(1)** Use of speed = distance/time **(1)** speed = 0.18 – 0.25 m s $^{-1}$ **(1)** <u>Example of calculation</u> Measurement = 0.55 cm Distance = 0.55 × 10^{-2} m× 12 = 6.6 × 10^{-2} m speed = $\frac{6.6 \times 10^{-2}\ \text{m}}{0.33\ \text{s}}$ speed = 0.20 m s^{-1}	**4**
19(c)(i)	(Stokes' law is only for) small (solid) spheres **Or**(Stokes' law is only for) laminar flow **Or** there is turbulent flow **(1)** Additional/less drag due to the bubbles having a non-stationary surface **Or** Stokes' law cannot be applied to a gas bubble because they have a non-stationary surface **Or** sides of container too close to bubbles **Or** volume/shape changes as it rises **(1)**	**2**
***19(c)(ii)**	(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate) **Either: Resultant forces method 4 marks** Measure the diameter/radius of the sphere (from the photograph) **(1)** Use of $4\pi r^3/3$ to find the volume of the sphere **(1)** Use $V\rho g$ to find the upthrust **/** weight of the bubble **(1)** Drag = upthrust – weight **(1)** **Or: Stokes' law method 2 marks** Measure the diameter/radius of the sphere (from the photograph) **(1)** Calculate the (terminal) velocity using $v = s/t$ **and** substitute into $F = 6\pi r\eta v$ **(1)**	**4**
	Total for question 19	**18**

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