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Mark Scheme (Results)

Summer 2014

Pearson Edexcel GCE
in Physics (6PH01)
Paper 01R 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)	<u>Horizontal force of hinge on table top</u> 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. '<u>resonance</u>'
   - 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] [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	✓ ✓ ✓	3

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

Question Number	Answer		Mark
11(a)(i)	A = work done (by friction/drag/brakes on the car) **Or** decrease in kinetic energy (due to friction/drag/brakes)	**(1)**	**1**
11(a)(ii)	B = car is travelling at a (lower) constant velocity	**(1)**	**1**
11(b)	A quantity with both magnitude and direction Acceleration/momentum/force/lift/drag/thrust/weight	**(1)** **(1)**	**2**
	Total for question 11		**4**

Question Number	Answer		Mark
12	The graph for sample A (for small extensions obeys Hooke's law as it) is a straight line through the origin The graph for B is not a straight line (through the origin)	**(1)** **(1)** **(1)**	**3**
	Total for question 12		**3**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>13(a)(i)</td><td>Identifies that the two chocolates on the graph are at different temperatures (1)

The greater the temperature of the chocolate, the lower the viscosity (1)</td><td>2</td></tr>
<tr><td>13(a)(ii)</td><td>Marked anywhere vertically above 10^{1} Pa s. (1)</td><td>1</td></tr>
<tr><td>13(b)</td><td>Use of drag = upthrust (1)

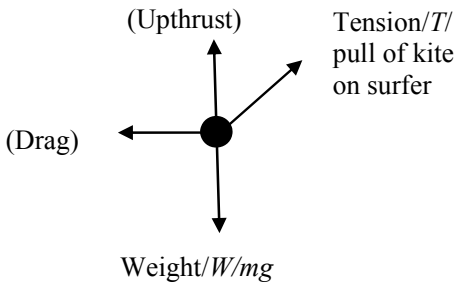
Use of $F = 6\pi r\eta v$ (1)

$v = 2.0 \times 10^{-4}$ m s^{-1} (1)

<u>Example of calculation</u>
$v = \frac{3.7 \times 10^{-5}\ \text{N}}{6 \times \pi \times 1.0 \times 10^{-3}\ \text{m} \times 10\ \text{Pa s}}$
$v = 1.96 \times 10^{-4}$ m s^{-1}</td><td>3</td></tr>
<tr><td>13(c)</td><td><table><tr><td>Problem</td><td>Bubbles forming and not rising to the surface to break</td></tr><tr><td>Solution</td><td>Reduce the viscosity of the chocolate Or heat up the chocolate (1)</td></tr><tr><td>Explanation</td><td>The greater the viscosity: the greater the viscous drag Or the lower the (terminal) velocity (1)
The bubbles rise slower (1)
OR
The lower the viscosity: the lower the viscous drag Or the greater the (terminal) velocity (1)
The bubbles are able to rise to the top quicker Or the bubblies rise to the top in time before the chocolate sets (1)</td></tr></table>(The 3 marking points can be awarded if seen anywhere within part (c))</td><td>3</td></tr>
<tr><td></td><td>Total for question 13</td><td>9</td></tr>
</table>

Question Number	Answer		Mark
14(a)	Static domino now has an unbalanced force acting on it so starts to move/fall **Or** falls from rest **Or** accelerates **Or** Before it is hit, the static domino has no unbalanced force on it (so) remains at rest	**(1)** **(1)** **(1)** **(1)**	**2**
***14(b)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** <u>The bottom coin is knocked out from under the stack</u> Only the bottom coin is given a force **Or** bottom coin has an unbalanced force on it Bottom coin starts to move **Or** accelerates <u>The flicked coin stops</u> Stacked/bottom coin gives the flicked coin a force **Or** force on flicked coin due to N3. The resultant force on the flicked coin is opposite to the direction of motion **Or** the flicked coin decelerates <u>The stack drops down</u> The remaining stacked coins do not receive any horizontal force (so stay still horizontally) The stacked coins now have an unbalanced vertical force (and drop) **Or** there is now only weight acting (vertically)	 **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**6**
14(c)	The idea that the direction of the (force of the flicked) coin on the stack is in a different direction (to initial direction of travel) The idea that the force from stack on (flicked) coin is in a different direction (to initial direction of travel) (Accept a labelled diagram indicating an off-centre collision)	**(1)** **(1)**	**2**
	Total for question 14		**10**

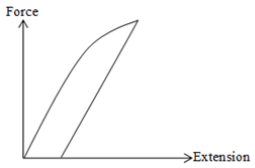
Question Number	Answer		Mark
15(a)(i)	1 velocity correct 2 or 3 velocities correct 4 velocities correct (no unit error) 0.66 | 0.42 0.91 | 0.58	**(1)** **(1)** **(1)**	**3**
15(a)(ii)	A (Can be implied within the answer) The idea that the time increments are smaller **Or** the idea that the velocity is (constantly) changing **Or** Not B(Can be implied within the answer) As B gives the value over the whole journey **Or** B does not take into account that the velocity of the battery is (constantly) changing	**(1)** **(1)**	**1**
15(b)	<u>Source of error:</u> (Human) reaction time **Or** recording the exact position of the battery at the correct time **Or** parallax when marking the position of the battery <u>Changes to the method:</u> Film/video camera with a measuring tape/scale along the ramp (and watch frame by frame) **Or** Motion sensor Connected to a computer/data logger (to directly plot/record distance against time) **Or** Strobe (as a timer) Set with a frequency of 1 Hz (or any sensible frequency suggested with a reason)	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**3**
	Total for question 15		**7**

Question Number	Answer		Mark
16(a)(i)	Tension line and arrow correctly drawn and labelled Weight line and arrow correctly drawn and labelled  (Tension can be on either side. If 2 marks have been awarded subtract 1 mark if the drag has been included and is not a horizontal force opposing the tension)	**(1)** **(1)**	**2**
16(a)(ii)	Use of correct trig function to find horizontal component of the tension $T_{horizontal}$ = 840 (N) Example of calculation Horizontal component of tension = $T\cos\theta$ $T_{horizontal}$ = 1100 N × cos 40° $T_{horizontal}$ = 843 N	**(1)** **(1)**	**2**
16(a)(iii)	$T_{vertical}$ = 1100 sin 40° **Or** $T_{vertical}$ = 707 (N) seen Use of $W = mg$ Use of $mg = U + T_{vertical}$ with a sensible statement discussing what would happen if $T_{vertical}$ = W **Or** $T_{vertical}$ > weight **Or** $T_{vertical}$ < weight e.g. $T_{vertical}$ = W **Or** mass = 72 kg: Upthrust is zero $T_{vertical}$ > weight **Or** mass < 72 kg: Can't have a negative upthrust $T_{vertical}$ < weight **Or** mass > 72 kg : To provide some upthrust Example of calculation $T_{vertical} = T \sin 40°$ (= 707 N) **OR** $mg = U + T_{vertical}$ $mg = U + 707$ N mass = $\frac{707 \text{ N}}{9.81 \text{ N kg}^{-1}}$ = 72.1 kg	**(1)** **(1)** **(1)**	**3**

***16(b)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** C **(1)** **Max 3** The horizontal component of the tension in the line produces the forward force acting on the surfer **Or** horizontal component of tension = $T\cos\theta$ (accept $T_{horizontal} = 1100\cos\theta$) **(1)** As the angle to the horizontal (θ) decreases **Or** As the angle to the vertical (θ) decreases ➔ $T\cos\theta$ increases **Or** the forwards force on the surfer increases **Or** the smallest θ gives the maximum/greatest force **(1)** Work done increases **(1)** Power transferred to surfer= $\frac{\text{work done}}{\text{time}}$ has increased hence the power increases **Or** more work done per second on the surfer so the power increases **(1)**	**4**
	Total for question 16	**11**

Question Number	Answer		Mark
17(a)(i)	Convex curve drawn from the box to the drop zone	**(1)**	**1**
17(a)(ii)	Use of $s = ut + \frac{1}{2} at^2$ t = 3.6 (s) Example of calculation 63 m = 0 + (½ × 9.81 m s^{-2} × t^2) t = 3.6 s	**(1)** **(1)**	**2**
17(a)(iii)	Use of speed = $\frac{\text{distance}}{\text{time}}$ Distance = 270 m (ecf) [300 m using the show that value] Example of calculation 75 m s^{-1} = $\frac{\text{distance}}{3.6\text{ s}}$ Distance = 270 m	**(1)** **(1)**	**2**
17(b)(i)	Use of GPE = mgh GPE = 6.2 (kJ) (A unit is required for an answer in J to score MP2) Example of calculation GPE = 10.0 kg × 9.81 N kg^{-1} × 63 m GPE = 6180 J	**(1)** **(1)**	**2**
17(b)(ii)	Use of KE = ½ mv^2 KE = 28.1 (kJ) (A unit is required for an answer in J to score MP2) Example of calculation KE = ½ × 10.0 kg × (75 m s^{-1})^2 KE = 28 125 J	**(1)** **(1)**	**2**
17(b)(iii)	KE at bottom = 34.3 kJ (ecf) Example of calculation KE at bottom = 6180 J + 28 125 J = 34 305 J	**(1)**	**1**
17(b)(iv)	Work is done against air resistance **Or** energy transferred due to air resistance	**(1)**	**1**
17(c)	Reduces the acceleration of the package **Or** reduces the speed on impact of the package **Or** has a lower terminal velocity **Or** less (resultant) force on the package	**(1)**	**1**
	Total for question 17		**12**

Question Number	Answer		Mark
18(a)	Ductile	**(1)**	
	Produces a large plastic deformation **Or** will deform permanently	**(1)**	
	under tension **Or** tensile stress **Or** tensile force	**(1)**	**3**
18(b)(i)	Use of density = $\frac{\text{mass}}{\text{volume}}$ **Or** see upthrust = ρVg	**(1)**	
	Use of upthrust = mass of water displaced x g	**(1)**	
	Upthrust = 0.026 N	**(1)**	
	Idea that the effect of the upthrust is more significant for the nylon than for the copper (e.g. a quantitative comparison made between the 2 net forces **Or** a sensible comment linking the upthrust to the 2 weights)	**(1)**	
	Or		
	Use of density = $\frac{\text{mass}}{\text{volume}}$	**(1)**	
	Use of weight = mass × g	**(1)**	
	Density $_{\text{copper}}$ = 8625 kg m^{-3} **Or** density $_{\text{nylon}}$ = 1098 kg m^{-3}	**(1)**	
	Comparison of the densities of both copper and nylon to that of sea water e.g. the density of nylon is only just greater than that of sea water so it almost floats whilst the density of copper is much greater than that of sea water so it will fall rapidly	**(1)**	**4**
	<u>Example of calculations</u> Mass of water displaced by either line = 1030 kg m^{-3}× 1.30 × 10 $^{-7}$ m^2 × 20.0 m = 2.68 × 10^{-3} kg Upthrust = 2.68 × 10^{-3} kg × 9.81 N kg^{-1} = 0.0263 N Net downwards force on Copper = 0.220 N – 0.0263N = 0.194 N Net downwards force on nylon = 0.0280 N – 0.0263 N = 0.00170 N		

(b)(ii)	Use of either stress = $\frac{\text{load}}{\text{cross sectional area}}$ **Or** strain = $\frac{\text{extension}}{\text{original length}}$ **Or** see $E = \frac{Fx}{A\triangle x}$ Use of Young modulus = $\frac{\text{stress}}{\text{strain}}$ **Or** use of $E = \frac{Fx}{A\triangle x}$ Extension = 0.0775 m <u>Example of calculation</u> Stress = $\frac{65.0\text{ N}}{1.30 \times 10^{-7}\ \text{m}^2} = 5.00 \times 10^8$ Pa **Or** strain = $\frac{\text{extension}}{20.0\text{ m}}$ 129×10^9 Pa = 5.00×10^8 Pa $\div \frac{\text{extension}}{20.0\text{ m}}$ Extension = 0.0775 m	**(1)** **(1)** **(1)**	**3**
(c)(i)	Loading graph to include elastic(straight) line and some plastic(curved) section Unloading line showing a permanent extension Unloading line to be parallel to the loading line  	**(1)** **(1)** **(1)**	**3**
(c)(ii)	Line becomes more sensitive **Or** all work done is used to reel in fish **Or** no/less work done on extending the line **Or** all force supplied pulls in fish **Or** less force required (to reel in fish) **Or** less (elastic /plastic) stretch **Or** elastic limit increases	**(1)**	**1**
	Total for question 18		**14**

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