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Mark Scheme (Results)

Summer 2014

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.

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] [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:

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

Question Number	Answer		Mark
11a(i)	(V =) $4/3\ \pi(d/2)^3$ **Or (** V =)$1/6\pi d^3$ (To get this mark the symbol d must be used)	**(1)**	**1**
11a(ii)	(mass of helium in the balloon =) $V\rho_h$ **Or** (mass of helium in the balloon =) $4/3\ \pi(d/2)^3\ \rho_h$ **Or** $\pi d^3\rho_h/6$ (ecf for volume from part (a)(i))	**(1)**	**1**
11a(iii)	(mass of displaced air =) $V\rho_a$ **Or** $4/3\ \pi(d/2)^3\ \rho_a$ **Or** $\pi d^3\rho_a/6$ (ecf for volume from part (a)(i))	**(1)**	**1**
11a(iv)	(Upthrust acting on the balloon =) $V\rho_a g$ **Or** $4/3\ \pi(d/2)^3\ \rho_a g$ **Or** $\pi d^3\rho_a g/6$ (ecf for volume from (a)(i) and mass of displaced air from (a)(iii) and accept $m_a g$)	**(1)**	**1**
11b	(Weight =) Upthrust (– weight of helium) **Or (**weight **=)** $4/3\ \pi(d/2)^3\ \rho_a g$ ($-\ 4/3\ \pi(d/2)^3\ \rho_h g$) **Or (**weight **=)** $V\rho_a g$ – ($V\rho_h g$) (ecf from parts (a)(i)-(iv))	**(1)**	**1**
	Total for question 11		**5**

Question Number	Answer	Mark
12(a)(i)	Brittle **(1)**	**1**
12(a)(ii)	Smaller pieces have a greater surface area (to volume ratio) **(1)**	**1**
12(b) (i)	Resistant to indentation/scratching **Or** surface is resistant to plastic deformation **(1)**	**1**
12(b)(ii)	There is less friction (between the blade and the ice)for cold/hard ice **Or** There is more friction (between the blade and the ice) for warm ice **(1)** There is less indentation/sinking/scratching for cold ice **Or** There is more indentation/sinking/scratching for warm ice **(1)**	**2**
	Total for question 12	**5**

Question Number	Answer		Mark
13(a)(i)	See (or use of) $E = \dfrac{F \times x}{A \times \Delta x}$ in any arrangement (accept l for x) (accept seeing or use of E = $\dfrac{F/A}{\Delta x/x}$) $\dfrac{\Delta x_C}{\Delta x_S} = \dfrac{E_S A_S}{E_C A_C}$ **Or** Calculate $E_C A_C$ (104) and $E_S A_S$ (234) or their reciprocals (962 and 427) (ignoring powers of ten at this stage) $\dfrac{\Delta x_C}{\Delta x_S} = 2.2 / 2.3$ Or ratio is 2.2/2.3:1 <u>Example of calculation</u> $\dfrac{\Delta x_C}{\Delta x_S} = \dfrac{E_S A_S}{E_C A_C}$ $\dfrac{\Delta x_C}{\Delta x_S} = \dfrac{1.3 \times 10^{-6}\ \text{m}^2 \times 1.8 \times 10^{11}\ \text{Pa}}{0.8 \times 10^{-6}\ \text{m}^2 \times 1.3 \times 10^{11}\ \text{Pa}}$ $\dfrac{\Delta x_C}{\Delta x_S} = 2.25$	**(1)** **(1)** **(1)**	**3**
13(a) (ii)	Use of $\Delta x_C + \Delta x_S = 0.01$ **Or** use of ratio 2.25:1 with 0.01 m Extension = 6.9 × 10^{-3} m to at least 2 SF (ecf from part (a)(i)) (show that value gives extension = 6.7 × 10^{-3} m) <u>Example of calculation</u> $2.25x + x = 0.01$ $\dfrac{0.01 \times 2.25}{3.25} = 6.92 \times 10^{-3}$ m	**(1)** **(1)**	**2**
13(b)	Ductility/ductile	**(1)**	**1**
	Total for question 13		**6**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>14(a)</td><td>
Use of pythagoras Or trigonometry to find the resultant velocity (1)
$v = 1.9\ \text{m s}^{-1}$ (1)
Use of trig to find the direction (1)
Direction = 54° (1)

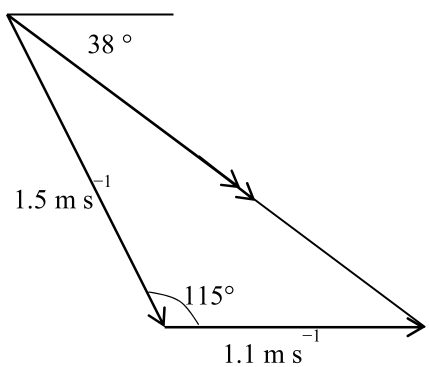
<u>Example of calculations</u>
$v = \sqrt{(1.1\ \text{m s}^{-1})^2 + (1.5\ \text{m s}^{-1})^2}$

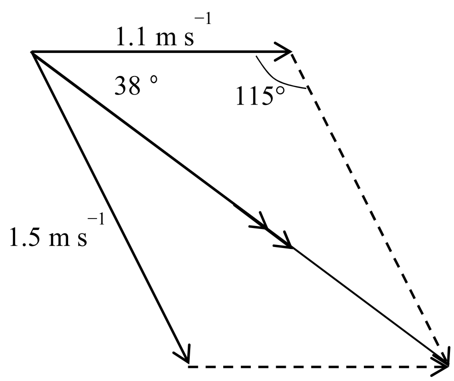
$v = 1.86\ \text{m s}^{-1}$

$\text{Direction} = \tan^{-1}\dfrac{1.5\ \text{m s}^{-1}}{1.1\ \text{m s}^{-1}}$
Direction = 53.74 °
</td><td>4</td></tr>
<tr><td>14(b)</td><td>
Construction of a correct vector triangle or parallelogram (from which a measurement for the resultant could be made) (1)

$v = 2.2 \pm 0.1\ \text{m s}^{-1}$ (1)

Direction = 38 ± 2° (1)

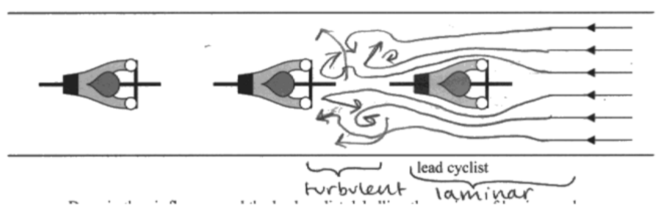
(Correct answers calculated mathematically rather than with a vector diagram will only score MP2 and MP3)


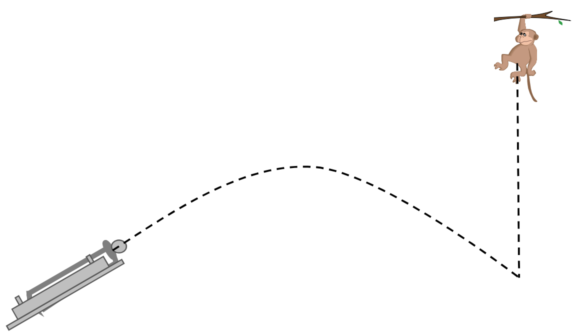


</td><td>3</td></tr>
<tr><td></td><td>Total for question 14</td><td>7</td></tr>
</table>

Question Number	Answer		Mark
***15(a)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** **Max 5** Solid (CO_2) exerts a force on the gas (CO_2) N3 means (gas exerts) a force on the solid/X Force is in opposite direction on the solid/gas There is a resultant/unbalanced force (on the solid) N2/1 means the (solid) accelerates (accept changes velocity/speed) Rapid because mass/friction is small (No mark for a statement of Newton's Laws)	 **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**5**
15(b)	More than one jet Zero/no resultant force **Or** forces balanced/cancel	**(1)** **(1)**	**2**
	Total for question 15		**7**

Question Number	Answer		Mark
16 (a)	Same (downwards) acceleration **Or** acceleration = g (accept constant acceleration)	**(1)**	**1**
16 (b)(i)	The ball is in contact with the floor (accept the ball bounces)	**(1)**	**1**
16 (b) (ii)	Lower gradient **Or** the lines would be not be as steep	**(1)**	**1**
16 (c)	Use of equation(s) of motion to find s **Or** use of distance = area under the graph **Or** use of GPE = KE s = 1.1 m – 1.4 m <u>Example of calculation</u> $(4.7 \text{ m s}^{-1})^2 = (0 \text{ m s}^{-1})^2 + (2 \times 9.81 \text{ m s}^{-2} \times s)$ s = 1.13 m	**(1)** **(1)**	**2**
16(d)(i)	Use of KE = ½ mv^2 KE = 1.1 – 1.3 (J) (no ue) <u>Example of calculation</u> KE = ½ × 0.40 kg × $(2.4 \text{ m s}^{-1})^2$ = 1.15 J	**(1)** **(1)**	**2**
16(d)(ii)	Use of GPE = KE h = 0.27 m – 0.32 m (ecf from 16(d)(i)) (If area under graph or an equation of motion is used e.g. $h = \frac{(u+v)t}{2}$ or $v^2 = u^2 + 2as$ only MP2 can be scored) <u>Example of calculation</u> $h = \dfrac{1.2 \text{ J}}{0.4 \text{ kg} \times 9.81 \text{ Nkg}^{-1}}$ h= 0.31 m	**(1)** **(1)**	**2**
16(e)	(Elastic potential) energy transferred to thermal energy **Or** energy dissipated as heat	**(1)**	**1**
	Total for question 16		**10**

Question Number	Answer	Mark
17 (a)(i)	Laminar alone to handlebar (at least from front wheel and 4 lines) and some turbulant behind **(1)** (laminar: continuous lines, not crossing, not bending sharply, no eddies) A region of laminar and turbulent correctly labelled for candidates drawing **(1)** 	**2**
17 (a)(ii)	Velocity of the lead cyclist relative to the air is greater (than that of the 2nd cyclist) **Or** air flow around the bicycle is greater for lead cyclist **Or** lead cyclist has increased the speed of the air **(1)** More (air) resistance/drag on lead cyclist **(1)** (Allow opposite for 2nd cyclist)	**2**
17(b)	4 × force required (allow air resistance, drag, cyclist's force, friction etc) **(1)** See or used $P = Fd/t$ **Or** $P \propto v$ **Or** $P = Fv$ **(1)** Power = $8P$ **(1)** <u>Example of calculation</u> Power = (force × distance) /time $P = (kv^2 \times d)/t$ New power $P_{\text{faster}} = (k(2v)^2 \times 2d)/t$ $P_{\text{faster}} = 8\,(kv^2 \times d)/t = 8P$	**3**
17(c)(i)	30 (°C) as the drag is lower **Or** 30 (°C) because cyclist can travel faster for the same drag **(1)** (accept high/largest instead of 30 (°C))	**1**
17(c)(ii)	Use of work done = force × distance **(1)** Difference in work done at these temperature = 8800 J (accept Nm) **(1)** (accept 9000 J as 4 km is to 1 sf) <u>Example of calculation</u> Difference in work done = (66.4 N – 64.2 N) × 4 000 m Difference in work done = 265600 − 256800 = 8800 J	**2**
	Total for question 17	**10**

Question Number	Answer		Mark
18(a) (i)	Use of correct equation(s) of motion to be able to find t $t = 0.23$ (s) (no ue) <u>Example of calculation</u> $0.25\text{ m} = (0 \times t) + ½ \times 9.81\text{ m s}^{-2} \times t^2$ $t = 0.23$ s	**(1)** **(1)**	**2**
18(a) (ii)	Use of $\text{speed} = \dfrac{\text{distance}}{\text{time}}$ Distance = 0.59 m - 0.60 m (ecf) (show that value gives $d = 0.52$ m) <u>Example of calculation</u> $d = 2.6\text{ m s}^{-1} \times 0.23\text{s}$ $d = 0.60$ m	**(1)** **(1)**	**2**
18(b)(i)	 Ball has a curved path with a decreasing gradient and the monkey' path is downwards Initial path of ball parallel to launcher and monkey approximately vertical with paths intersecting below initial position of monkey (Allow a small gap between the paths approximately the width of monkey)	**(1)** **(1)**	**2**
18(b)(ii)	Use of $\text{speed} = \dfrac{\text{distance}}{\text{time}}$ with cos 20˚ to find the time of the drop Use of $s = ut + ½ at^2$ with $u = 0$ Distance fallen = 0.15 m – 0.16 m <u>Example of calculation</u> $t = \dfrac{0.50\text{ m}}{3\cos 20°} = 0.177\text{ s}$ $s = ½ \times 9.81\text{ m s}^{-2} \times (0.177\text{ s})^2$ $s = 0.154$ m	**(1)** **(1)** **(1)**	**3**
	Total for question 18		**9**

Question Number	Answer	Mark
19 (a)	Use of Δx = (1.12 × diameter − diameter) e.g. $\Delta x = 1.27 \times 10^{-11}$ m **(1)** Use of $F = k\Delta x$ **(1)** $F = 1.4 \times 10^{-8}$ N **(1)** <u>Example of calculation</u> $\Delta x = 0.12 \times 1.06 \times 10^{-10}$ m $= 1.27 \times 10^{-11}$ m $F = 1130$ N m$^{-1} \times 1.27 \times 10^{-11}$ N $F = 1.44 \times 10^{-8}$ N	**3**
19 (b)(i)	**Max 3** For positive force/extension the spring is in tension/stretched/extended **(1)** **(**accept after/right of origin) For negative force/extension the spring is in compression/squashed **(1)** **(**accept before/left of origin) From −0.7 (± 0.1) N to 1.5(± 0.1) N the spring obeys Hooke's law **(1)** At 1.5 (± 0.1) N the spring has reached its elastic limit (allow limit of proportionality, yield point) **Or** at –0.9 (± 0.1) N the spring is fully compressed (allow coils touching) **(1)** (answers may be given in terms of extension 1.5 N →7.6 (± 0.4) cm, −0.9 N → −4.0 (± 0.4) cm and − 0.7 N → − 3.6 (± 0.4) cm)	**3**
19 (b)(ii)	Use of gradient **Or** pairs of points from the graph within the linear region **(1)** $k = 20$ N m^{-1} Or 0.20 N cm^{-1} (allow 19 to 21 N m^{-1}) **(1)** <u>Example of calculation</u> gradient = $\frac{7.4 \times 10^{-4}\ \text{m}}{1.5\ \text{N}}$ = 0.0493 m N^{-1} $k = \frac{1}{\text{gradient}} = \frac{1}{0.0493} = 20.3$ N m^{-1}	**2**
***19(c)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** **MP1 and 2 are for atom separation decreasing** When pushed together the repulsive force is the greater force **(1)** (because) the repulsive graph is steeper (at smaller separations) **Or** repulsive force increases more rapidly **(1)** **MP3 is for atom separation increasing.** When pulled apart the repulsive force is the smaller force **Or** repulsive force is zero but attractive force is still present **(1)**	**3**
	Total for question 19	**11**

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