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Mark Scheme (Results)

Summer 2016

Pearson Edexcel International Advanced Level in Physics (WPH01) 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.

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 e.g. '**and'** when two pieces of information are needed for 1 mark.

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 This does not apply in 'show that' questions or in any other question where the units to be used have been given, for example in a spreadsheet.

2.3 The mark will not be awarded for the same missing or incorrect unit only once within one clip in epen.

2.4 Occasionally, it may be decided not to insist on a 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.

2.5 The mark scheme will indicate if no unit error is to be applied by means of [no ue].

3. Significant figures

3.1 Use of too many significant figures in the theory questions will not be prevent a mark being awarded if the answer given rounds to the answer in the MS.

3.2 Too few significant figures will mean that the final mark cannot be awarded in 'show that' questions where one more significant figure than the value in the question is needed for the candidate to demonstrate the validity of the given answer.

3.3 The use of one significant figure might be inappropriate in the context of the question e.g. reading a value off a graph. If this is the case, there will be a clear indication in the MS.

3.4 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 mean that one mark will not be awarded. (but not more than once per clip). Accept 9.8 m s^{-2} or 9.8 N kg^{-1}

3.5 In questions assessing practical skills, a specific number of significant figures will be required e.g. determining a constant from the gradient of a graph or in uncertainty calculations. The MS will clearly identify the number of significant figures required.

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.

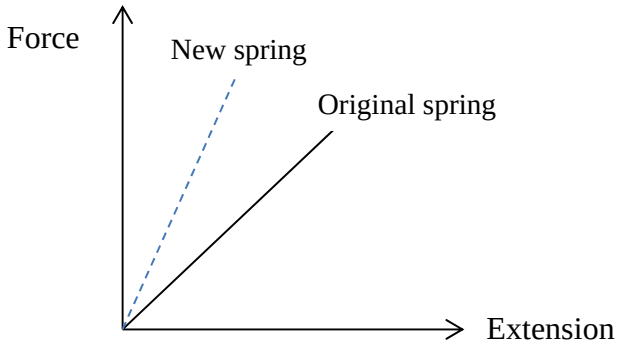
4.5 The mark scheme will show a correctly worked answer for illustration only.

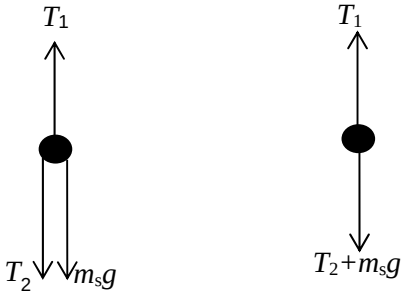
Question Number	Answer	Mark
1	B	**1**
2	B	**1**
3	C	**1**
4	A	**1**
5	D	**1**
6	D	**1**
7	B	**1**
8	A	**1**
9	D	**1**
10	D	**1**

Question Number	Answer	Mark
11	Use of $\sigma = \frac{F}{A}$ (1) Use of cross sectional area = πr^2 **and** d = 2r (1) Diameter = 1.6×10^{-3} m (1) Example of calculation 500×10^6 Pa $= \frac{950\text{ N}}{A}$ A = 1.9×10^{-6} m^2 Diameter = $\sqrt{\frac{4 \times (1.9 \times 10^{-6}\text{ m}^2)}{\pi}}$ Diameter = 0.00156 m	**3**
	Total for Question 11	**3**

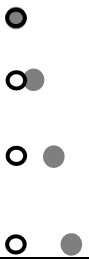
Question Number	Answer	Mark
12	**Identifies what is wrong:** (Definition) should be for a change in stress **Or** statement could be referring to any part of the plastic region (accept beyond yield point or elastic limit but **not** limit of proportionality) (1) **What the yield point is:** The yield point is onset of plastic deformation **Or** at/beyond the yield point there is little or no increase in force/stress required to produce (this large extension) (1)	**2**
	Total for Question 12	**2**

Question Number	Answer	Mark
13(a)	Copper is malleable (1) Can be hammered/beaten/bent into shape (1)	**2**
13(b)	Steel is stiff **Or** steel has a high Young modulus (1) Does not bend / deform (1) (If neither MP is scored then strong **Or** high UTS scores MP1 only)	**2**
	Total for Question 13	**4**

Question Number	Answer	Mark
14(a)(i)	Less compression / extension / Δx (**must be comparative**) (1) Driver / passenger less comfortable **Or** driver / passenger feels the shock **Or** car body not kept at the same level **Or** the drive is more bumpy. (1)	**2**
14(a)(ii)	Straight line starting from (0,0) above the original line (1)  	**1**
14(b)	Use of $F = k\Delta x$ (1) $(\Delta)x = 0.316 - 0.205$ (= 0.111 m) stated or implied (allow −ve here only) (1) $k = 3.67 \times 10^4$ N m^{-1} (1) Example of calculation $\triangle x = 0.316$ m – 0.205 m = 0.111 m 4.07×10^3 N = $k \times 0.111$ m $k = 3.67 \times 10^4$ N m^{-1}	**3**
	Total for Question 14	**6**

Question Number	Answer	Mark
15(a)(i)	T_1 up (1) T_2 / W_f / $m_f g$ down (1) W_s / $m_s g$ down (1) (Arrows must touch dot and be nearly vertical) (Accept a single line down with two labelled arrow heads. Accept a single arrow with T_2 +/and W_s.) (-1 for each extra force) (subscripts needed for weight and tension)  	**3**
15(a)(ii)	For the Spider : $T_1 = m_s g + m_f g$ **Or** $T_1 = m_s g + T_2$ (no ecf from (i)) (1) For the fly : $m_f g = T_2$ (1) (equations must be in terms of m and T as in the question)	**2**
15(b)	Resultant force = $(m_s + m_f)g - T_1$ (= 5.3×10^{-3} N) (1) Use of $F = ma$ (1) $a = 7.2$ m s^{-2} (1) (Do not penalise negative values) Example of calculation $m_s + m_f = 7.3 \times 10^{-4}$ kg $((7.3 \times 10^{-4}\text{ kg}) \times 9.81\text{ N kg}^{-1}) - 1.9 \times 10^{-3}\text{ N} = (7.3 \times 10^{-4}\text{ kg})a$ $a = 7.2$ m s^{-2}	**3**
	Total for Question 15	**8**

Question Number	Answer	Mark
16(a)	Use of $W = mg$ (1) Use of trig to find the vertical component of tension (1) $T = 640$ (N) (1) Example of calculation $mg = 2T\sin\theta$ $(84\text{ kg} \times 9.81\text{ N kg}^{-1}) = 2 \times T \times \sin 40°$ $T = 641$ N	**3**
***16(b)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** The idea that the horizontal force is the significant force. (1) $T_H = T\cos\theta$ (1) $T = T_V / \sin\theta$ (1) T_V does not change **Or** T_V = (½) weight (1) The horizontal component of tension/force decreases (as θ increases) **Or** Tension decreases (as θ increases) (1)	**5**
	Total for Question 16	**8**

Question Number	Answer	Mark
17(a)(i)	Use of $s = ut + ½ at^2$ with $u = 0$ (or equivalent) (1) Time = 6 x 1/20 (= 0.30 s) (1) s = 0.44 (m) (1) <u>Example of calculation</u> s = 0 + ½ × 9.81 N kg^{-1} × (0.30 s)^2 s = 0.44 m	**3**
17(a)(ii)	Measured vertical distance = 5.7 cm ± 0.1 cm **Or** correct horizontal distance between two points ± 0.1 cm (e.g. X to Y = 2.0 cm, 1st to 2nd bounce = 3.8 cm, 1st to 3rd bounce 7.1 cm total distance = 9.1 cm) (1) Use of scale calculation to calculate a horizontal distance (1) Use of $v = s/t$ (1) v = 0.49 to 0.61 m s^{-1} (ecf value from (a)(i) (1) (Use of show that value (0.4 m) gives 0.44 to 0.56 m s^{-1}) <u>Example of calculation</u> $\frac{5.7\,\text{cm}}{3.8\,\text{cm}} = \frac{0.44\,\text{m}}{s}$ s = 0.293 m $v = \frac{0.293\,\text{m}}{11/20\,\text{s}} = 0.53\,\text{m s}^{-1}$	**4**
17(b)	The idea that energy is transferred to thermal/internal energy (during bounce) (1) **e.g.** energy is dissipated as heat **Or** bounce is inelastic. (Do not credit references to frictional forces) Velocity / speed / KE (after bounce) is less (than velocity before bounce) (1)	**2**
17(c)(i)	All four balls vertically above one another (1) All four balls horizontally next to original balls (1) 	**2**
17(c)(ii)	No horizontal velocity so fall is vertical **Or** No horizontal velocity so fall is down only **Or** No horizontal velocity so no horizontal displacement / distance (1) Same vertical acceleration (so same vertical position) (1)	**2**
	Total for Question 17	**13**

Question Number	Answer	Mark
***18(a)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** the oar exerts a force on the water (1) by N3 the water exerts an opposite force (on the oar) (1) there is a resultant / net / unbalanced force (1) by N1/N2 the boat accelerates (1)	**4**
18(b)(i)	work done = area under the graph (1) Value in range of 400 - 600 (J) (1) Accurate value in range 501 - 540 (J) (1) Example of calculation 0.2 0 m × 100 N = 20 J 26.2 squares × 20 J = 524 (J)	**3**
18(b)(ii)	See/use power = $\frac{\text{work done}}{\text{time}}$ (1) **Or** divides energy by time per stroke (60/24 or 2.5 s) Multiplies energy by rate (24/60 or 0.4 s^{-1}) (1) Power = 210 W (ecf from part (b)(i)) (show that value gives 200 W) (1) Example of calculation Time per stroke = 60/24 = 2.5 s Power = $\frac{524\,\text{J}}{2.5\,\text{s}} = 210\,\text{W}$	**3**
18(c)	Friction / drag / resistance with the water (1) (causes) K.E. / turbulence / movement of the water (1)	**2**
18(d)	(The boat and the rower have the same velocity but) the rower and the boat have different masses (1)	**1**
	Total for Question 18	**13**

Question Number	Answer	Mark
19(a)(i)	No abrupt change in direction/speed of flow **Or** no eddies **Or** fluid flows in layers/flow lines/streamlines **Or** no mixing of layers **Or** layers remain parallel **Or** velocity at a (particular) point remains constant **(1)** (smooth and streamlined are not sufficient)	**1**
19(a)(ii)	**Any 2 from:** Small object **(1)** Smooth surface **(1)** Low/small velocity **(1)**	**2**
19(b)(i)	Distance between markers **(1)** Diameter of the ball bearing **(1)**	**2**
19(b)(ii)	Weight of the ball bearing **(1)**	**1**
19(b)(iii)	Upthrust **Or** weight of glycerol/fluid displaced (by the ball bearing) **(1)**	**1**
19(b)(iv)	Calculate the velocity (of the ball bearing) (for each drop) **Or** use $v=h/t$ **(1)** Plot v against r^2 (or t against $1/d^2$ etc.) **(1)** Determines/calculates/measures the gradient **(1)** $\eta = \frac{2g(\rho_b - \rho_g)}{9 \times \text{gradient}}$ **Or** $\text{gradient} = \frac{2g(\rho_b - \rho_g)}{9 \times \eta}$ Or correct alternative **(1)** (only allow MP2, MP3 & MP4 if a straight line would be produced) (do not allow MP2 if graph axes are complex, e.g. $W_b - W_g$ against $6\pi rv$) (Allow converse answer for a graph of r^2 against v)	**4**
19(c)	At a low temperature: the flow rate (of the glycerol) is reduced/slower **Or** speed (of the glycerol) decreases **Or** (the glycerol) moves slowly **(1)** (Do not credit ref to nitrogen removal or flow of waste water) the viscosity is high/large/increased **(1)** (do not accept "thicker") (marks not awarded for answer is in terms of increasing temperature and decreasing viscosity as it is not in the context of the question)	**2**
	Total for Question 19	**13**

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