Mark Scheme (Results)

Summer 2018

Pearson Edexcel
International Advanced Subsidiary 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.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate.

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. '<u>resonance</u>'

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.

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.

  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	The only correct answer is **D** A is not correct because work done is a scalar. B is not correct because velocity is a vector. C is not correct because weight is a vector.	**1**
2	The only correct answer is **C** A is not correct because it gives Ns in base units. B is not correct because it gives N in base units. D is not correct because gives Pa in base units.	**1**
3	The only correct answer is **C** A is not correct because brittle materials do not deform plastically. B is not correct because ductile materials deform under tension. D is not correct because tough is about the energy required to fracture.	**1**
4	The only correct answer is **C** C is correct because acceleration is 30/7.5 A is not correct because 0.53 is $30/7.5^2$ B is not correct because 2.0 is 30/(2×7.5) D is not correct because 8.0 is 2×30/7.5	**1**
5	The only correct answer is **B** A is not correct because Q has the same change in E_{grav}. C is not correct because R is lifted a smaller distance. D is not correct because R has the smallest change in E_{grav}.	**1**
6	The only correct answer is **D** The work done is the area to the left of the line on the graph. A is not correct because it is the work done for a constant force. B is not correct because it is the work that would be done if the spring obeyed Hooke's law. C is not correct because it represents the area under the line on the graph.	**1**
7	The only correct answer is **C** This object is decelerating because the gradient of the graph is decreasing. A is not correct because the object would be accelerating. B is not correct because the object would be accelerating. D is not correct because there would be no change of velocity.	**1**
8	The only correct answer is **C** A is not correct because they are equal according to Newton's third law. B is not correct because $N_t > N_b$ due to the weight of the box. D is not correct because $N_t > W_t$ due to the weight of the box.	**1**
9	The only correct answer is **A** B is not correct because $N_t > N_b$ due to the weight of the box. C is not correct because the two forces are acting on the same object. D is not correct because $N_t > W_t$ due to the weight of the box.	**1**
10	The only correct answer is **C** C is correct because half the force is on each spring so the spring constant is doubled, which will halve the extension for a given load. A is not correct because the extension is halved, not doubled. B is not correct because the spring constant is doubled, not halved. D is not correct because the spring constant is doubled, not halved.	**1**

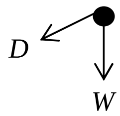
Question Number	Answer		Mark
11(a)	Use of $F = 6\pi\eta rv$ (with the diameter or the radius) $v = 1.1\ \text{m s}^{-1}$ (Use of diameter for radius gives $0.54\ \text{m s}^{-1}$ for MP1 only) <u>Example of calculation</u> $1.0 \times 10^{-5}\ \text{N} = 6 \times \pi \times 9.0 \times 10^{-4}\ \text{Pa s} \times 0.5 \times 1.1 \times 10^{-3}\ \text{m} \times v$ $v = 1.07\ \text{m s}^{-1}$	(1) (1)	**2**
11(b)	**Max 1** The stone is a sphere The stone is smooth The flow is laminar The flow is not turbulent (Ignore ref to low/constant velocity, that the stone is small, that the viscosity/temperature is constant)	 (1) (1) (1) (1)	**1**
	Total for question 11		**3**

Question Number	Answer		Mark
12	Use of $v = s/t$ north to south with v=1.1 m s^{-1} to determine time (68.2 s)	(1)	
	Use of $v = s/t$ west to east with v = 0.55 m s^{-1} and calculated t	(1)	
	Distance XY = 38 m (accept 37.0 – 38.0)	(1)	
	Or		
	$\tan\theta = \frac{1.1}{0.55}$ **Or** $\sin\theta = \frac{1.1}{\sqrt{1.1^2 + 0.55^2}}$ **Or** $\cos\theta = \frac{0.55}{\sqrt{1.1^2 + 0.55^2}}$	(1)	
	(θ = 63.4°. Allow similar trig to give θ = 26.6°)		
	$XY = \frac{75}{\tan\theta}$	(1)	
	XY = 38 m (accept 37.0 – 38.0)	(1)	
	Or		
	Use of Pythagoras to determine resultant velocity (1.23 m s^{-1})	(1)	
	Use of $v = s/t$ north to south with v=1.1 m s^{-1} to determine time (68.2 s)	(1)	
	Distance XY = 38 m (accept 37.0 – 38.0)	(1)	
	Or		
	Calculate ratio of velocities	(1)	
	Correctly equate ratio of velocities to ratio of distances	(1)	
	XY = 38 m (accept 37.0 – 38.0)	(1)	**3**
	<u>Example of calculation</u>		
	$t = \frac{75\,\mathrm{m}}{1.1\,\mathrm{m\,s^{-1}}} = 68.2\,\mathrm{s}$		
	Distance XY = 0.55 m s^{-1} × 68.2 s = 37.5 m		
	Total for question 12		**3**

Question Number	Answer	Mark
13(a)	There is a deceleration then an acceleration. (1) The initial deceleration/change is due to friction/drag. (1) The final acceleration/change is due to magnetic force/field/attraction. (1)	**3**
13(b)	Use of gradient of the graph **Or** Uses $\Delta v/\Delta t$ (1) (must be taken at or beyond 0.5 s) Attempt to draw tangent at 0.64 s (1) a = 2.8 to 3.6 m s^{-2} (1) <u>Example of calculation</u> $\text{Acceleration} = \dfrac{(0.50 - 0)\ \text{m s}^{-1}}{(0.65 - 0.49)\ \text{s}} = 3.1\ \text{m s}^{-2}$	**3**
	Total for question 13	**6**

Question Number	Answer	Mark
14(a)	A material that absorbs a large amount of energy (per unit volume) without/before fracture **Or** a material that undergoes a large amount of plastic deformation without/before fracture **Or** a material that can withstand a large impact (force) without/before fracture (1)	**1**
14(b)(i)	Centre of gravity/mass (1)	**1**
14(b)(ii)	Energy transfer = $mg\,(H - h)$ (1)	**1**
14(c)	As the temperature increases the toughness increases **Or** at low temperature the steel is not (very) tough and at high temperatures the steel is tough(er) (1) At low temperatures, the steel is brittle **Or** The steel becomes less brittle as temperature increases **Or** if the material is not very tough it will be brittle (1) At high temperatures, the steel is malleable **Or** the steel becomes more malleable as the temperature increases **Or** if the material is tough it will be malleable (1) (accept a specific temperature or range in place of low or high) (ignore ref to viscosity) (Accept converse statements for temperature decreasing) (Any symbols used must be defined)	**3**
	Total for question 14	**6**

<table>
<tr><th>Question Number</th><th>Answer</th><th></th><th>Mark</th></tr>
<tr><td>15(a)(i)</td><td>Weight /W/ mg
Air resistance/drag /AR/D /F_D
(angle to the horizontal for the air resistance must not be 0 or 90° by eye)



(Ignore upthrust if correctly drawn vertically upwards.
Otherwise max 1 if more than two forces are drawn)</td><td>(1)
(1)</td><td>2</td></tr>
<tr><td>*15(a)(ii)</td><td>(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)

One mark from each cell of the table for any one of the statements

<table>
<tr><th>Difference between paths</th><th>Explanation (mark dependent upon the difference)</th></tr>
<tr><td><u>For path P:</u>

Less distance is travelled

Range is less</td><td><u>Horizontal</u> velocity is decreasing/less

Ball is slowing down <u>horizontally</u>

Ball has a <u>horizontal</u> deceleration

There is a backward <u>horizontal</u> force on the ball

Ball is in the air for a shorter time</td></tr>
<tr><td><u>For path P:</u>

Maximum height reached is lower

The path is lower</td><td>The <u>vertical</u> deceleration is greater

The (average) <u>vertical</u> velocity is lower

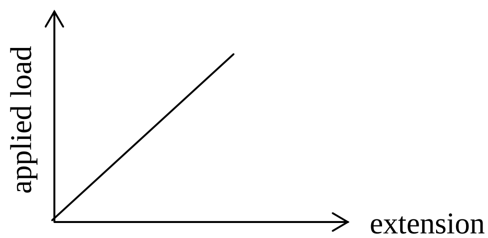
As the ball rises, there is a greater downward force</td></tr>
</table>

(For horizontal/vertical allow x-direction, y-direction)
(Allow the opposite comparisons in terms of path Q)</td><td>(1)
(1)

(1)
(1)</td><td>4</td></tr>
</table>

15(b)	See (u_H =) 35cos25° or 32 (m s^{-1}) or (u_V =) 35sin25° or 15 (m s^{-1}) (1) Correct use of vertical equations to find the full time of flight (1) Use of $s = u_H t$ to find the range (1) Horizontal distance travelled = 96 (m) (>85 m) so six 'runs' are scored. (1) **Or** See (u_H =) 35cos25° or 32 (m s^{-1}) or (u_V =) 35sin25° or 15 (m s^{-1}) (1) Correct use of vertical equations to find the full time of flight (1) Use of $u_H = s/t$ with s = 85 m to find the time to the boundary (1) Time of flight = 3.0 (s) **and** time to boundary = 2.7 (s) so six 'runs' are scored (1) **Or** See (u_H =) 35cos25° or 32 (m s^{-1}) or (u_V =) 35sin25° or 15 (m s^{-1}) (1) Use of $v = s/t$ with s = 85 m to find the time to the boundary (1) Correct use of vertical equations to find the height at the boundary (1) Height = 4.4 (m) so six 'runs' are scored. (1) <u>Example of calculation</u> $t = \dfrac{0-(35\ \mathrm{m\ s^{-1}} \times \sin 25°)}{-9.81\ \mathrm{N\ kg^{-1}}} = 1.508\ \mathrm{s}$ time to same height = 3.02 s horizontal distance at 3.02 s = (35 m s^{-1}× cos25°) × 3.02 s = 95.80 m	**4**
	Total for question 15	**10**

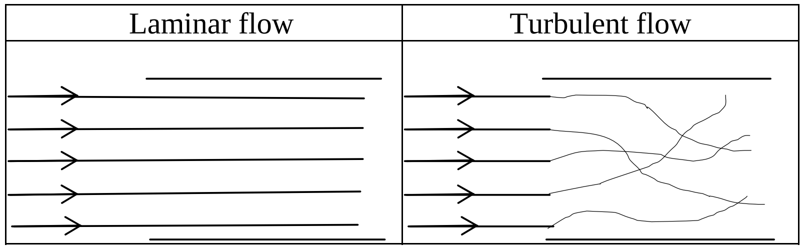
Question Number	Answer		Mark
16(a)	Instead of external force they should refer to resultant/net/unbalanced force No motion is not always true As there could be uniform motion (in a straight line) **Or** "No motion" should be no acceleration (MP1 not given if it includes an incorrect discussion of internal forces) (MP3, accept constant velocity/speed for uniform motion) (MP1 and MP3 could come from a correct statement of the law)	(1) (1) (1)	**3**
***16(b)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** Pulling gives an upward force (on the trolley) (not if it is stated that the weight decreases) (so) the normal contact force is less (so) the friction is less (so) less force F'_m is required from the person due to the friction $W = F \times d$ where F is the friction or horizontal component of F'_m (so the work done is less) (Allow converse for pushing)	(1) (1) (1) (1) (1)	**5**
	Total for question 16		**8**

<table>
<tr><th>Question Number</th><th>Answer</th><th></th><th>Mark</th></tr>
<tr><td>17(a)</td><td>Diameter (of the wire)
Original length (of the wire)</td><td>(1)
(1)</td><td>2</td></tr>
<tr><td>17(b)(i)</td><td>Straight line through origin

</td><td>(1)</td><td>1</td></tr>
<tr><td>17(b)(ii)</td><td>Use the gradient
$$\text{Young modulus} = \text{gradient} \times \frac{\text{original length}}{\text{cross sectional area}}$$
(Symbols used must be defined)</td><td>(1)
(1)</td><td>2</td></tr>
<tr><td>17(c)</td><td>Max 4

Can only score from 2 of the table rows, and just 1 mark for each cell.
<table>
<tr><th>Advantage of first experiment</th><th>Explanation dependent on the advantage</th></tr>
<tr><td>Use of micrometer (not if to measure diameter)</td><td>Can measure extension/length/position with:
Or micrometer has:
Or less (percentage) uncertainty
Or better precision/resolution
Or the metre rule only measures to 1 mm while the micrometer measures to the nearest 0.01 mm</td></tr>
<tr><td>Use of control/reference /second wire</td><td>Avoids the effect of:
temperature changes
Or sag in the support</td></tr>
<tr><td>There is no pulley</td><td>Measurement of tension/force more accurate/reliable
Or Friction would reduce the tension/force in the wire.</td></tr>
</table></td><td>(1)
(1)

(1)
(1)

(1)
(1)</td><td>4</td></tr>
<tr><td></td><td>Total for question 17</td><td></td><td>9</td></tr>
</table>

Question Number	Answer		Mark
18(a)	Laminar: continuation of given lines that are approximately parallel (minimum of three) Turbulent: Continuation of given lines that cross **Or** Eddies  	(1) (1)	**2**
18(b)(i)	See $E_k + E_{grav}$ See $½mv^2 + mgh$ See Pt = Energy See $\rho = m/V$ **and** use to give the equation **Or** see $m = \rho Q$ **and** use to give the equation	(1) (1) (1) (1)	**4**
18(b)(ii)	Conversion of flow rate to m^3 s^{-1} Use of $P = \frac{1}{2}\rho Q v^2 + \rho Qgh$ P = 0.42 W Example of calculation P = (½ × 1100 kg m^{-3} × (95 × 10^{-6} m^3 s^{-1}) ×(0.45 m s^{-1})^2) + (1100 kg m^{-3}) × (95 × 10^{-6} m^3 s^{-1}) × (9.81 N kg^{-1}) × 0.40 m) P = 0.0106 + 0.410 = 0.421 W	(1) (1) (1)	**3**
18(b)(iii)	Friction/drag (between blood and the walls of the arteries/veins) **Or** viscosity (has been ignored) Work has to be done against friction. (Allow viscous force, resistive force, drag)	 (1) (1)	**2**
	Total for question 18		**11**

Question Number	Answer		Mark
19(a)(i)	See resultant force = weight (of system) – upthrust Use of $(\Sigma)F = ma$ $a = 4.5\ \text{m s}^{-2}$ <u>Example of calculation</u> $(470\ \text{kg})\ a = (470\ \text{kg})(9.81\ \text{N kg}^{-1}) - 2500\ \text{N}$ $a = 4.49\ \text{m s}^{-2}$	(1) (1) (1)	**3**
19(a)(ii)	Drag increases with speed (The system moves with a constant velocity when:) the resultant force = 0 **Or** when weight = upthrust + drag	(1) (1)	**2**
19(a)(iii)	Drag force = 2100 N <u>Example of calculation</u> $(470\ \text{kg})(9.81\ \text{N kg}^{-1}) - 2500\ \text{N} = 2111\ \text{N}$	(1)	**1**
19(b)	Correct use of 2500 N divided by 10 (could be later in the calculation) (Do not credit if drag or weight of the system is being used for the calculation of d) Use of $W = mg$ (Divide by 9.81) Use of $\rho = m/V$ (Divide by 1030) Use of $V = \frac{4}{3}\pi\left(\frac{d}{2}\right)^3$ Diameter of floatation sphere = 0.36 m <u>Example of calculation</u> Upthrust on 1 sphere = 2500 N ÷ 10 = 250 N Mass of displaced water = 250 N ÷ 9.81 N kg^{-1} = 25.5 kg Volume of displaced water = $\text{Volume of displaced water} = \frac{25.5\ \text{kg}}{1030\ \text{kg m}^{-3}} = 0.0248\ \text{m}^3$ $0.0248\ \text{m}^3 = \frac{4}{3}\pi\left(\frac{d}{2}\right)^3$ $d = 0.362\ \text{m}$	(1) (1) (1) (1) (1)	**5**
19(c)(i)	(Strength is) the stress needed to break **Or** (High strength means) it needs a large stress to break There is a large tension/upthrust/weight (on the chain) (Not force – must relate to the equipment)	(1) (1)	**2**
19(c)(ii)	(There is an additional force from) the currents in the sea **Or** (There is an additional force from) the movement of the seawater (ignore references to the normal reaction force from the seabed and other forces that act)	(1)	**1**
	Total for question 19		**14**

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