Mark Scheme (Results)

October 2017

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.

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.

Physics Specific Marking Guidance

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:

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.]

This has a clear statement of the principle for awarding the mark, supported by some examples illustrating acceptable boundaries.

Mark scheme format

- Bold lower case will be used for emphasis.
- Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".
- Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

Unit error penalties

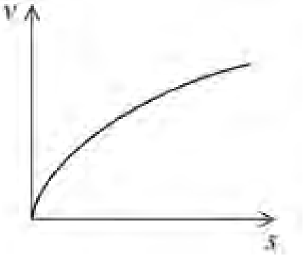
- A separate mark is not usually given for a unit but a missing or incorrect unit will normally cause the final calculation mark to be lost.
- Incorrect use of case e.g. 'Watt' or 'w' will not be penalised.
- There will be no unit penalty applied in 'show that' questions or in any other question where the units to be used have been given.
- The same missing or incorrect unit will not be penalised more than once within one question but may be penalised again in another question.
- 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.
- The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

Significant figures

- 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.
- Use of an inappropriate number of significant figures will normally be penalised in the practical examinations or coursework.
- Using $g = 10 \text{ m s}^{-2}$ **will** be penalised.

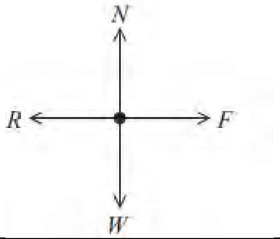
Calculations

- Bald (i.e. no working shown) correct answers score full marks unless in a 'show that' question.
- Rounding errors will not be penalised.
- 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.
- 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.
- recall of the correct formula will be awarded when the formula is seen or implied by substitution.
- The mark scheme will show a correctly worked answer for illustration only.

Question Number	Answer	Mark
1	**The only correct answer is D m s^{-2}**	**1**
	A *is not correct because s is the unit for time which is scalar* ***B*** *is not correct because* m^3 *is the unit for volume which is scalar* ***C*** *is not correct because* $m\ s^{-1}$ *is the unit for both speed and velocity so is both scalar and vector*	
2	**The only correct answer is B 60 m**	**1**
	A *is not correct because 30 m is the radius and half the displacement* ***C*** *is not correct because* 30π *is half the circumference of the inside of the track. It is the distance travelled and not the displacement* ***D*** *is not correct because* 60π *is the circumference of the inside of the track and is double the distance travelled*	
3	**The only correct answer is D 0.59 J**	**1**
	A *is not correct because* $0.045\ J = \frac{1}{2} \times 0.040\ kg \times (1.5\ m)^2$ ***B*** *is not correct because* $0.060\ J = 0.040\ kg \times 1.5\ m$ ***C*** *is not correct because* $0.39J = 0.040\ kg \times 9.81\ N\ kg^{-1}$	
4	**The only correct answer is C**  i.e. $v^2 \propto s$	**1**
	A *is not correct because this is a graph where* $v \propto s^2$ ***B*** *is not correct because this is a graph where* $v \propto -s$ ***D*** *is not correct because this is a graph where* $v \propto s$	
5	**The only correct answer is C viscosity of water**	**1**
	:***A*** *is not correct because the weight of the raindrop depends on the density of the water and is not negligible* ***B*** *is not correct because the drag force acing on the raindrop depends on the viscosity of the air and is not negligible* ***D*** *is not correct because the weight of the raindrop depends on the volume of the raindrop and is not negligible*	

<table>
<tr><td rowspan="2">6</td><td>The only correct answer is A Hard</td><td>1</td></tr>
<tr><td><i>B is not correct because the resistance to scratching of the surface of a material does not depend on the stiffness of the material</i>

<i>C is not correct because the resistance to scratching of the surface of a material does not depend on the strength of the material</i>

<i>D is not correct because the resistance to scratching of the surface of a material does not depend on the toughness of the material</i></td><td></td></tr>
<tr><td rowspan="2">7</td><td>The only correct answer is B

 </td><td>1</td></tr>
<tr><td><i>A is not correct because N must be perpendicular to the surface that the shoe is in contact with</i>

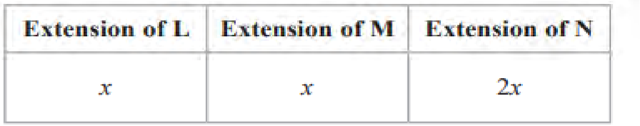
<i>C is not correct because F acts in a forward direction and N must be perpendicular to the surface that the shoe is in contact with</i>

<i>D is not correct because F acts in a forward direction</i></td><td></td></tr>
<tr><td rowspan="2">8</td><td>The only correct answer is C 5 m s^{-1}</td><td>1</td></tr>
<tr><td><i>A is not correct because 3 m s^{-1}is the speed of the air only</i>

<i>B is not correct because 4 m s^{-1}is the speed of the bird only</i>

<i>D is not correct because 7 m s^{-1} = 3 m s^{-1} + 4 m s^{-1}</i></td><td></td></tr>
<tr><td rowspan="2">9</td><td>The only correct answer is D 80 × g × 450 × sin25°</td><td>1</td></tr>
<tr><td><i>A is not correct because incorrect use of trigonometry to determine the vertical distance travelled</i>

<i>B is not correct because incorrect use of trigonometry to determine the vertical distance travelled</i>

<i>C is not correct because this expression uses the horizontal distance travelled which is 450 × cos25 ° and not the vertical distance travelled</i></td><td></td></tr>
<tr><td rowspan="2">10</td><td>The only correct answer is D
<table><tr><th>Extension of L</th><th>Extension of M</th><th>Extension of N</th></tr><tr><td>x</td><td>x</td><td>$2x$</td></tr></table></td><td>1</td></tr>
<tr><td><i>A is not correct because The extension of L, M and N will not be the same</i>

<i>B is not correct because M will have the same extension as L which is x and N will have double the extension to L and M</i>

<i>C is not correct because The extension of N is double that of L and M and not half</i></td><td></td></tr>
<tr><td></td><td>Total for multiple choice questions</td><td>10</td></tr>
</table>

Question Number	Answer		Mark
11	Viscosity is greater at lower temperatures **Or** temperature is inversely proportional to viscosity	(1)	
	This increases the (viscous) drag force (acting on the crystal)	(1)	
	The crystal moves more slowly **Or** the flow rate of the honey/crystal is lower **Or** the formation of larger crystals is reduced	(1)	**3**
	(accept converse for MP1 only)		
	Total for question 11		**3**

Question Number	Answer		Mark
12(a)	Use of $F = 6\pi\eta rv$	(1)	
	$F = 5.2 \times 10^{-4}$ N	(1)	**2**
	<u>Example of calculation</u> $F = 6 \times \pi \times 0.98$ Pa s $\times$ 4. 0 $\times 10^{-3}$ m $\times 7.1 \times 10^{-3}$ m s^{-1} $F = 5.246 \times 10^{-4}$ N		
12(b)	Two outer lines continue straight or slightly uninterrupted past ball bearing	(1)	
	Two inner lines curve around ball to become parallel once past the ball bearing (Do not award MP2 if any turbulent flow is included)	(1)	**2**
	(both sets of lines must go at least the length of one diameter beyond the ball bearing to award the marking point)		
	Total for question 12		**4**

Question Number	Answer		Mark
13(a)	Brass is ductile	(1)	
	(Large) permanent/plastic deformation under tension **Or** will not return to its original shape/length when the tensile force is removed **Or** can be drawn into shapes (under tension)	(1)	**2**
13(b)	Brass is malleable	(1)	
	Permanent/plastic deformation under compression **Or** will not return to its original shape/length when the compressive force is removed **Or** can be hammered into shape (under compression)	(1)	**2**
	Total for question 13		**4**

Question Number	Answer	Mark
14(a)	Use of area under the graph **Or** approximation to a triangle using $E_{el} = \frac{1}{2} F \Delta x$ (1) Number of small squares × 5 × 10^{-4} J **Or** number of large cm squares × 1.25 × 10^{-2} J **Or** area under graph approximated to a minimum of two shapes (1) Work done = 0.46 to 0.48 J (1) <u>Example of calculation:</u> Work done = 929 squares × 5 × 10^{-4} J = 0.465 J	**3**
14(b)	Curve drawn below given curve starting at the end of the given graph (1) Graph ending at beginning of the given graph (1)	**2**
	Total for question 14	**5**

Question Number	Answer	Mark
15(a)	20 m s^{-1} is the average velocity **Or** the velocity is not constant **Or** the car is accelerating (1) Tangent drawn onto graph at $t = 15$ s **Or** use of correct equations of motion with $u = 0$ (1) Velocity = 40 (m s^{-1}) (1) (Do not award MP2 for approximation of the curve to a straight line at 15 s) <u>Example of calculation</u> Gradient of tangent = $\frac{520\text{ m} - 100\text{ m}}{20.0\text{ s} - 10.5\text{ s}}$ = 44.2 m s^{-1}	**3**
15(b)	The acceleration is decreasing **Or** the rate of change of velocity is decreasing (1) Drag forces are increasing (with increased velocity) **Or** the car is heading towards terminal velocity **Or** the resultant force is decreasing due (to the increasing drag force) **Or** air resistance is proportional to velocity (squared) (1)	**2**
	Total for question 15	**5**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>16(a)</td><td>Either
Weight of <i>M</i> creates a force on the glider
Or the force on the glider is <i>Mg</i>
Or the tension in the string creates a force on the glider (1)

Tension in the string is constant Or resultant force is constant (1)

According to N2 there is a constant acceleration (1)

Or
the force on the glider is <i>Mg</i> (1)

so $a = \frac{Mg}{(M+m)}$ (1)

<i>M</i> and <i>m</i> are constant (1)

(MP3 for second route is dependent on MP2)</td><td>3</td></tr>
<tr><td>16(b)(i)</td><td>The smallest division/reading/scale/value/time that can be read/measured
Or smallest change in input that can be detected by the output (1)</td><td>1</td></tr>
<tr><td>*16(b)(ii)</td><td>(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)

Measure the distance between the light gates using a metre rule (1)

Record/measure the time (to travel between the light gates) (1)

Repeat the experiment with the second light gate at different positions along the track (and the first light gate in the same position)
Or repeat experiment with different distances (between the light gates) (1)

Plot an appropriate graph (1)

Description of how to obtain the acceleration from the gradient (1)
e.g.
<table>
<tr><th>Graph</th><th>$s - t^2$</th><th>$t^2 - s$</th><th>$2s - t^2$</th><th>$t^2 - 2s$</th><th>$t^2/2 - s$</th><th>$s - t^2/2$</th></tr>
<tr><td><i>a</i></td><td>2×gradient</td><td>2/gradient</td><td>gradient</td><td>1/gradient</td><td>1/gradient</td><td>gradient</td></tr>
<tr><td>Gradient</td><td>$a/2$</td><td>$2/a$</td><td>a</td><td>$1/a$</td><td>$1/a$</td><td>a</td></tr>
</table></td><td>5</td></tr>
<tr><td></td><td>Total for question 16</td><td>9</td></tr>
</table>

Question Number	Answer		Mark
***17(a)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)**		
	Constant horizontal speed/velocity **Or** there is no horizontal acceleration	(1)	
	Bike same horizontal distance apart in each image **Or** measurements taken from photograph to demonstrate this	(1)	
	The vertical velocity is increasing/decreasing **Or** vertical/downwards acceleration/deceleration	(1)	
	Images of increasing/decreasing vertical distance **Or** measurements taken from photograph to demonstrate this	(1)	**4**
	(treat as neutral any descriptions of the motion before the jump)		
17(b)(i)	Use of trig to determine the initial vertical velocity component	(1)	
	Use of equation(s) of motion to calculate the height	(1)	
	height = 13 m (ignore any negative signs seen)	(1)	**3**
	<u>Example of calculation:</u> Initial vertical velocity = 9.5 m s^{-1} × sin10 = 1.65 m s^{-1} s = (1.65 m s^{-1}× 1.8 s) + ½ (−9.81 m s^{-2} × $(1.8\ s)^2$) s = −12.9 m		
17(b)(ii)	Use of trig to determine the initial horizontal velocity component	(1)	
	Use of $v = s/t$	(1)	
	s = 17 m	(1)	**3**
	<u>Example of calculation:</u> Initial horizontal velocity = 9.5 m s^{-1} × cos10 = 9.36 m s^{-1} s = 9.36 m s^{-1}× 1.8s = 16.8 m		
17(c)	There is no normal/contact/reaction/upwards <u>force</u> acting on him (from the bike)	(1)	
	The cyclist is falling with the same acceleration as the bike **Or** the acceleration of the bike (and the cyclist) is g/9.81 (m s^{-2}) **Or** The cyclist (and the bike are both) falling freely **Or** weight is the only force acting on him	(1)	**2**
	Total for question 17		**12**

Question Number	Answer	Mark
18(a)	Use of $W = mg$ (1) Use of $\sigma = F/A$ (1) Use of $E = \sigma/\varepsilon$ (1) $\varepsilon = 3.8 \times 10^{-3}$ or 0.38 % (1) <u>Example of calculation:</u> $W = 0.960 \text{ kg} \times 9.81 \text{ N kg}^{-1} = 9.42\text{N}$ $\sigma = \frac{9.42 \text{ N}}{(1.0 \times 10^{-2} \text{ m})(1.0 \times 10^{-4} \text{ m})} = 9.42 \times 10^{6} \text{ Pa}$ $\varepsilon = \frac{9.42 \times 10^{6} \text{ Pa}}{2.5 \times 10^{9} \text{ Pa}}$ $\varepsilon = 3.77 \times 10^{-3}$	**4**
18(b)	The greater tension caused a greater extension (1) There is plastic/permanent deformation (1) The idea that the outside or side with greater tension is left longer so it bends to produce the curling. (1)	**3**
18(c)(i)	The greater the tension/stress, the smaller the diameter of the ribbon coil formed (1)	**1**
18(c)(ii)	The idea that the greater the area of the blade, the greater the diameter e.g. the sharper the edge, the smaller the diameter (1)	**1**
18(c)(iii)	Force/stress applied for a greater time **Or** ribbon stretched for greater time (1) There is a greater difference between the extensions (and the diameter decreases) (1)	**2**
	Total for question 18	**11**

Question Number	Answer	Mark
19 (a)	There is a downward force on the (ejected) water (1) due to N3 the (ejected) water exerts an (equal and opposite) force on the flyer/jet pack (1) There is a resultant force on the flyer/jet pack **Or** force of water on jet pack is greater than the weight (+ tension) (1) Flyer/jet pack accelerates upwards according to N1/2 **Or** the flyer/jet pack rises from rest according to N1/2 **Or** the flyer/jet pack starts to rise according to N1/2 (1)	**4**
19(b)(i)	Use of trig to determine the vertical component of tension **Or** Use of trig to determine the vertical component force of water on flyer (1) Use of $\Sigma F = ma$ e.g. $(F_w \times \cos 12) - W - (T \times \cos 40) = 0$ (allow $F_w - W - T = 0$) (1) $W = 702$ N (1) <u>Example of calculation:</u> $(F_w \times \cos 12) - W - (T \times \cos 40) = 0$ $W = (960 \text{ N} \times \cos 12) - (310 \text{ N} \times \cos 40)$ $W = 701.5$ N	**3**
19(b)(ii)	Use of $W = mg$ **Or** see 72 kg (1) See correct calculation for ΣF e.g. (960 × cos12) – 700 (1) $a = 3.3 \text{ m s}^{-2}$ ecf from (b)(i) (1) (show that value gives $a = 3.3 \text{ m s}^{-2}$) <u>Example of calculation:</u> Mass of system = 702 N/9.81 N kg^{-1} = 71.6 kg (960 N × cos12) – 702 N = 71.6 kg × a $a = 3.31 \text{ m s}^{-2}$	**3**

19(c)(i)	$V = Av$ (in 1 second) (1) Use of $\rho = m/V$ (1) v = 10.3 (m s^{-1}) (1) <u>Example of calculation:</u> $v = \frac{49.0 \text{ kg}}{1030 \text{ kg m}^{-3} \times (4.60 \times 10^{-3} \text{ m}^2)}$ v = 10.34 m s^{-1}	**3**
19(c)(ii)	Use of gain in GPE of the water = mgh (in 1 second) (1) Use of kinetic energy gained by the water = ½mv^2 (in 1 second) (1) See or use of minimum power of pump = gain in GPE (in 1 second) + KE of water (in 1 second) (1) P_{min} = 8400 W (1) (show that value: P_{min} = 8200 W) <u>Example of calculation:</u> $P_{\text{min}} = \frac{m}{t} gh + ½\frac{m}{t}v^2$ P_{min} = (49.0 kg s^{-1} × 9.81 N kg^{-1} × 12.0 m) + (½ × 49.0 kg s^{-1} × (10.3 m s^{-1}) P_{min} = 8367.5 W	**4**
	Total for question 19	**17**

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