Mark Scheme (Results)

Summer 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.

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.

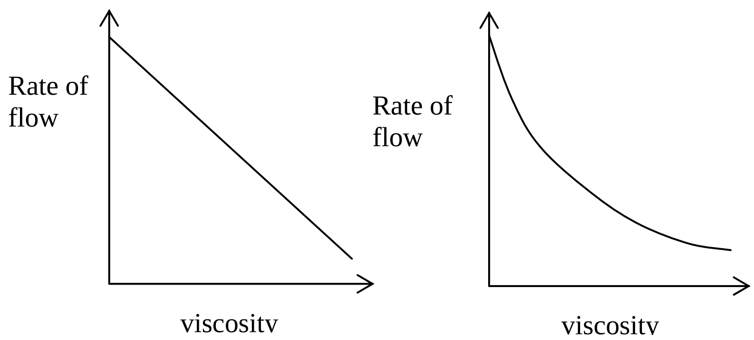
4.3 **use** of the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

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.

Question Number	Answer	Mark
1	**C – velocity, since velocity has both magnitude and direction.**	**1**
	Incorrect answers: A – distance has magnitude only. B – speed has magnitude only. D – work done has magnitude only.	
2	**D – N, as upthrust is a force.**	**1**
	Incorrect answers: A – $N\ m^{-2}$ is a unit of pressure. B – $N\ m^{-1}$ is a unit of spring constant. C − N m is a unit of work.	
3	**C – Y is the elastic limit.**	**1**
	Incorrect answers: A – *W* is the force required to fracture the wire. B – *X* is the yield point. D – *Z* is the limit of proportionality.	
4	**D – $mg - U - D = ma$ as this is $\Sigma F = ma$**	**1**
	Incorrect Answers: A – since this equation assumes the acceleration is zero. B – since this equation gives the total upward force while the acceleration is downwards. C − since this equation assumes the acceleration is zero.	
5	**B – $-7.5\ m\ s^{-2}$ as this is the gradient of the graph.**	**1**
	Incorrect Answers: A – because this answer is positive and the gradient is negative. C – an incorrect calculation of gradient (= 15/4), and positive. D – an incorrect calculation of gradient (= 15/4).	
6	**C – 30 m which is the magnitude of the area under each part of the graph added together.**	**1**
	Incorrect Answers: A – This is the final displacement. B – This is the area under one part of the graph. D – This is a wrong calculation (15 × 4)	

7	**A – since *R* = *W*cos*Θ* and when *Θ* increases cos*Θ* decreases.**	**1**
	Incorrect Answers: B – because sin*Θ* is incorrect. C – because *R* actually decreases. D − because *R* actually decreases and sin*Θ* is incorrect.	
8	**D – 50 N m^{-1} = 1.5 N / 0.030 m**	**1**
	Incorrect Answers: A – 0.02 comes from 0.030 m / 1.5 N B – 0.5 is the spring constant in N cm^{-1} C – 2 comes from 3.0cm / 1.5 N	
9	**C – since the horizontal velocity is constant.**	**1**
	Incorrect Answers: A – This cannot be correct since the horizontal velocity is constant. B – The vertical velocity is zero at the maximum height. D − The initial and final vertical velocities are different (i) because they are not at the same heights and so have different speeds, and (ii) because one is positive and the other is negative.	
10	**C – as it shows a constant acceleration for the constant resultant force.**	**1**
	Incorrect Answers: A – since this graph shows a constant velocity. B – since the graph is plotted against distance, not time. D − since this shows an increasing acceleration.	

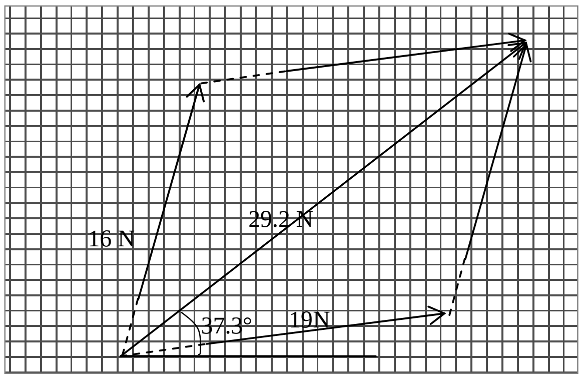
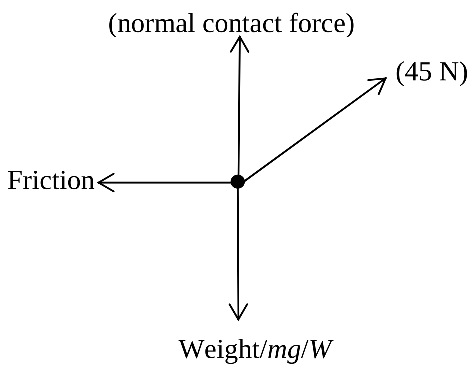
Question Number	Answer	Mark
11(a)	Increase of flow rate as viscosity decreases (accept a straight line or a curve of decreasing gradient) (1) [The graph can but does not have to touch either axis. No part with positive gradient.] 	**1**
11(b)	Viscosity increases/greater (as the temperature decreases) **Or** becomes more viscous (MP1 must be comparative) (1) reducing/slowing the (rate of) flow/velocity **Or** increasing the (fluid) friction/resistance/drag (1) A greater <u>force</u> is required (from the heart) (1)	**3**
	Total for question 11	**4**

Question Number	Answer		Mark
12(a)	Work is done by strip/rubber **Or** work is done on the ball Initial elastic/potential/strain energy (of the strip) becomes kinetic energy (of the ball) [Any transfer of GPE loses MP3 unless clearly stated to happen after the launch in which case it is ignored] Some PE becomes thermal energy (in the strip) [Do not allow some KE becomes thermal/internal energy.]	(1) (1) (1) (1)	**4**
12(b)	Use of $E_{elastic} = ½ F\Delta x$ Extension = 6.3×10^{-2} m Example of calculation 0.11 J = ½(3.5 N) × Δx Δx = 0.0629 m	(1) (1)	**2**
	Total for question 12		**6**

Question Number	Answer		Mark
***13**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** There is a downward force on A in addition to the weight (for downward allow towards B, away from spring balance etc) There is an opposite/upward force on B due to A Reading for magnet A increases **and** reading for magnet B decreases (By N3) the changes are equal **Or** (by N3) the forces between the magnets are equal	 (1) (1) (1) (1)	**4**
	Total for question 13		**4**

Question Number	Answer		Mark
14(a)	Total distance is used	(1)	
	(During the time interval) the speed could vary	(1)	**2**
14(b)	Measurement from diagram leading to a distance travelled of 6.1 m to 6.5 m **Or** measurement from diagram of 4.0 to 4.3 divisions × 1.52	(1)	
	Use of $v = s/t$	(1)	
	Correct conversion between m s^{-1} and km per hour [either actual speed or speed limit]	(1)	
	v = 44 to 47 (km per hour) **and** car not speeding **Or** v = 12 to 13 (m s^{-1}) **and** limit is 14 (m s^{-1}) **and** car not speeding	(1)	**4**
	Example of calculation Number of markings crossed in 0.5 s = 4.2 4.2 × 1.52 m = 6.38 m $v = \frac{6.38\text{ m}}{0.5\text{ s}} = 12.77\text{ m s}^{-1}$ $v = \frac{12.77\text{ m s}^{-1} \times 3600\text{ s}}{1000\text{ m}} = 46.0\text{ km per hour}$		
14(c)	Parallax error (in distance travelled by the car)	(1)	**1**
	Total for question 14		**7**

Question Number	Answer	Mark
15(a)	Reference to a tall container containing oil (1) [for tall on diagram accept at least twice as high as wide] Markers away from top and the bottom (1) (Measure) distance (between markers) using a metre rule (1) (Measure) time to fall/travel using a stop watch (1) Reference to repeating measurements (1) (For MP3 & 4 the apparatus can be in a separate list or labelled on a diagram. MP1 & 2 normally from a diagram)	**5**
***15(b)**	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** **In a vacuum** (the graph is a straight line as) the acceleration is constant/*g*/9.8 m s^{-2} (1) (because) the only force is the weight/*mg*/gravitational (1) (do not accept gravity) **In oil** (the graph curves then becomes horizontal) (1) there is also upthrust **and** drag as speed increases, drag force increases (1) Resultant force is/becomes zero **Or** U + D = W (1) acceleration decreases until terminal velocity is reached **Or** velocity becomes constant when terminal velocity is reached **Or** acceleration becomes zero when terminal velocity is reached (1)	**6**
	Total for question 15	**11**

Question Number	Answer		Mark
16(a)	16N and 19N drawn to scale in correct directions	**(1)**	
	Correct resultant drawn	**(1)**	
	Magnitude of resultant force = 29 N (allow 28.0 N to 30.0 N)	**(1)**	
	Direction of force to horizontal = 37° (allow 36.0° to 38.0°)	**(1)**	**4**
	(The two answer marks must be taken as measurements from their scale diagram)  		
16(b)(i)	<u>Friction</u>	**(1)**	
	Weight/*mg*/*W*	**(1)**	**2**
	 		
	(−1 if more than 2 forces drawn. Arrows must start on the dot and be horizontal and vertical. Ignore length of arrows. Labels must not be numbers)		
16(b)(ii)	See (T_v =) 45 sin 30° **Or** (T_v =) 45 cos 60°	**(1)**	
	Use of $W = mg$	**(1)**	
	Use of $N = W - T_v$	**(1)**	
	normal contact force of the ground on the box = 17 N	**(1)**	**4**
	<u>Example of calculation</u> normal contact force + (45 N)(sin 30°) – (4.0 kg × 9.81 N kg^{-1}) = 0 normal contact force = 16.7 N		
	Total for question 16		**10**

Question Number	Answer	Mark
17(a)	Malleable (1) (Another property given negates mark) Will undergo (a large amount of) plastic deformation under compression. (1)	**2**
17(b)(i)	*Yield point* – the point at/beyond which there will be a large increase in extension/strain for little/no increase in (applied) stress/load/force (1) *Tensile strength* –stress at which the material will break/fracture **Or** Maximum stress before fracture/breaking (1) When under tension **Or** when being stretched (1)	**3**
17(b)(ii)	Use of strain = $\Delta x/x$ (1) Addition of extension to original length (1) Length at fracture = 90 cm / 0.90 m (1) Example of calculation $0.12 = \frac{\Delta x}{80\,\text{cm}}$ Δx = 9.6 cm Length at fracture = 80 cm + 9.6 cm = 89.6 cm	**3**
17(c)	The mass (of aluminium) is lower (than for steel frame) (1) [must be a comparative statement] **Either:** For the same force (from the cyclist) (1) the acceleration is greater (1) **Or:** For the same kinetic energy (1) the speed is greater (1) [Assume the candidate is discussing aluminium. Accept the reverse argument for steel as long as steel is clearly stated throughout]	**3**
	Total for question 17	**11**

Question Number	Answer		Mark
18(a)(i)	Use of power = 660 × mass (or see 4.62)	**(1)**	
	Use of energy transferred = power × time (allow power = 660)	**(1)**	
	Use of $E_k = ½ mv^2$	**(1)**	
	v = 1.1 (m s^{-1})	**(1)**	**4**
	[since *m* cancels it is possible to get 1.1 if 2 mistakes are made – need to check the working. Ignore power of ten errors in the mass] <u>Example of calculation</u> Power supplied by body = (660 W kg^{-1}) × (0.70 × 10^{-6} kg) = 4.62 × 10^{-4} W Energy transferred = (4.62 × 10^{-4} W) × (0.85 × 10^{-3} s) = 3.93 × 10^{-7} J $v = \sqrt{\dfrac{2\times3.93\times10^{-7}\ \text{J}}{0.70\times10^{-6}\ \text{kg}}}$ v = 1.06 m s^{-1}		
18(a)(ii)	Use of $a = \dfrac{v-u}{t}$	**(1)**	
	a = 1200 or 1300 m s^{-2} (ecf v or "show that" value)	**(1)**	**2**
	<u>Example of calculation</u> $a = \dfrac{1.06\ \text{m s}^{-1} - 0}{0.85\times10^{-3}\ \text{s}}$ a = 1250 m s^{-2}		

18(b)	v_v = 1.2 sin 39° Or v_v = 1.2 cos 51° Or v_v = 0.755 **(1)** Use of equation(s) of motion to determine the time for the entire jump or half the jump. **(1)** Distance = 1.2 cos 39° × time (allow any time) **(1)** Horizontal distance travelled = 0.14 m **(1)** <u>Alternative scheme using range equation:</u> See $s_H = \frac{u^2 \sin 2\theta}{g}$ No marks if this equation is incorrect. **(1)** All substitutions correct [−1 for each error] **(2)** horizontal distance travelled = 0.14 m **(1)** <u>Example of calculation</u> u_v= (1.2 m s^{-1}) × (sin 39°) = 0.755 m s^{-1} $-9.81\,\text{m s}^{-2} = \frac{0-0.755\,\text{m s}^{-1}}{t}$ t = 0.0770 s time for jump = 2 × 0.0770 s = 0.154 s u_h= (1.2 m s^{-1}) × (cos 39°) = 0.933 m s^{-1} horizontal distance travelled = 0.154 s × 0.933 m s^{-1} = 0.144 m		**4**
18(c)(i)	Use of $E = \sigma/\varepsilon$ **(1)** Use of strain = 1 **(1)** Use of $\sigma = F/A$ to obtain a value for the applied force **(1)** Use of $\frac{\text{energy from pads}}{\text{total jump energy}} \times 100\,\%$ (with energy from 1 or both pads) **(1)** Percentage of energy from the pads = 48% to 49% (do not allow if only one pad used with $E = Fx$) **(1)** <u>Example of calculation</u> $1.8\times10^{6}\ \text{Pa} = \frac{F}{(60\times10^{-6}\ \text{m})^2} \div 1$ F = 6.48× 10^{-3} N E_{el}= ½ × (6.48× 10^{-3} N) × (60 × 10^{-6} m) = 1.94 × 10^{-7} J ((1.94 × 10^{-7} J × 2)/ 0.80× 10^{-6} J) × 100 = 48.6 %		**5**
18(c)(ii)	Elastic **Or** high elastic limit **(1)** Low stiffness **Or** low Young modulus **(1)** [Only give 2 marks if there are no incorrect properties]		**2**
	Total for question 18		**17**

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