Mark Scheme (Results)

June 2017

Pearson Edexcel
GCE Advanced Subsidiary in Physics (8PH0/01)
Paper 1 Core Physics I

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June 2017
Publications Code 8PH0_01_MS_1706*

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.

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.

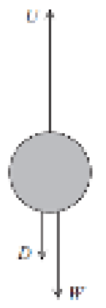
4.2 If a 'show that' question is worth 2 marks. then both marks will be available for a reverse working; if it is worth 3 marks then only 2 will be available.

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.

PHYSICS AS 8PH0/01 (1706) mark scheme – version 3

Question Number	Answer	Mark
1	**B distance**	**1**
	Incorrect Answers: A – acceleration is a vector quantity C – momentum is a vector quantity D – velocity is a vector quantity	
2	**A area under an acceleration-time graph**	**1**
	Incorrect Answers: B – this is equivalent to the displacement C – this is equivalent to the rate of change of acceleration D − this is equivalent to the acceleration	
3	**C** 	**1**
	Incorrect Answers: A – this is the diagram for a bead moving downwards with a constant velocity B – this is the diagram for a bead moving upwards with a decreasing velocity D – this is the diagram for a bead moving downwards with a decreasing velocity	
4	**D 1080 C**	**1**
	Incorrect Answers: A – current divided by time, with the time in seconds B – current divided by time, with the time in minutes C – correct formula of current × time but the time is in minutes and not seconds	

5	**D Step 4**	**1**
	Incorrect Answers: A – this step uses the conservation of energy B – this step is just a statement of Ohm's law C – this step uses the conservation of energy	
6	**C** $\boldsymbol{vt\ sin\ 35°}$	**1**
	Incorrect Answers: A – correct formula but initial vertical velocity and not horizontal velocity used B – incorrect formula used with initial vertical velocity D – incorrect formula used with initial horizontal velocity	
7	**D** $\boldsymbol{\frac{R_2}{R_1+R_2}V}$	**1**
	Incorrect Answers: A – this looks similar to the correct formula but has an incorrect resistance as the numerator and does not have the total resistance as the denominator B – this looks similar to the correct formula with the correct resistance as the numerator but does not have the total resistance as the denominator C – This would give the PD across resistor R_1 and not R_2	
8	**A dark and cold**	**1**
	Incorrect Answers: B – correct description for LDR but incorrect for thermistor C – incorrect description for LDR but correct for thermistor D – incorrect description for LDR and incorrect for thermistor	

(Total for Multiple Choice Questions = 8 marks)

Question Number	Acceptable answers	Additional guidance	Mark
9(a)	• Due to the internal resistance of the cell **(1)** • There is a potential difference across the internal resistance of the cell **Or** there will be 'lost volts' **Or** $V = \mathcal{E} . - Ir$ **(1)**		**2**
9(b)	• Identifies $\mathcal{E}$ = 1.36 V **(1)** • Use of $I = V/R$ with R = 5.92 Ω and V = 0.84 V **(1)** • Use of $\mathcal{E} = V + Ir$ **Or** equivalent to determine r **(1)** • r = 3.7(Ω) **(1)** • Both are correct (because r has increased and $\mathcal{E}$ has decreased) **(1)**	MP1: This may be implied in a calculation MP3: allow either e.m.f. to be sub for the use of mark MP5: descriptions of r and V both required MP5: conditional mark on MP4 <u>Example calculation</u> I = 0.84 V / 5.92 Ω I = 0.142 A 1.36 V = 0.84 V + 0.142 A × r r = 3.66 Ω	**5**

(Total for Question 9 = 7 marks)

Question Number	Acceptable answers		Additional guidance	Mark
10(a)	• Caliper 1 gives reading to the nearest 0.01 mm • Caliper 2 gives reading to the nearest 0.1 mm • Technique comparison • Statement that due to variation in diameter extra resolution of caliper 1 is irrelevant **Or** percentage error/uncertainty for caliper 1 is lower	**(1)** **(1)** **(1)** **(1)**	**MP1 and MP2,** only penalise for no unit once. Ignore references to decimal places **Examples for MP3** Caliper 2 involves judgement of which lines are aligned Caliper 1 gives direct reading Caliper 2 has parallax error	**4**
10(b)	• Use of πr^2 or $\pi d^2/4$ • Use of $I = nAvq$ • $v = 5.8$ to 6.0×10^{-7} m s^{-1}	**(1)** **(1)** **(1)**	<u>Example of calculation</u> Cross sectional area = $\pi \frac{(12.2 \times 10^{-3}\text{ m})^2}{4} = 1.2 \times 10^{-4}$ m^2 1.9 A = 1.7×10^{29} m^{-3} × 1.2×10^{-4} m^2 × v × 1.6×10^{-19} C $v = 5.8 \times 10^{-7}$ m s^{-1}	**3**

(Total for Question 10 = 7 marks)

Question Number	Acceptable Answer		Additional guidance	Mark
11(a)	• Use of $v = u + at$ • Max acceleration from 0-60 time = 2.8 (m s^{-2})	(1) (1)	<u>Example of calculation</u> $\frac{(60 \times 1600)\text{ m}}{(60 \times 60)\text{ s}} = 0 + a \times 9.5$ s Max acceleration = 2.8 m s^{-2}	2
11(b)	• Use of $v^2 = u^2 + 2as$ • Max speed with manufacturer's acceleration = 18 m s^{-1} **Or** acceleration shown by police = 3.3 m s^{-2} • Decision **and** evidence required consistent with calculated values	(1) (1) (1)	<u>Examples for MP3</u>: e.g. 18.3 m s^{-1} is lower than 20 m s^{-1} so should be challenged e.g. 18.3 m s^{-1} is lower than the maximum speed so should be challenged e.g. The police are suggesting a greater acceleration than the manufacturers, so it should be challenged e.g. The maximum speed achievable is less than that suggested by the police, so it should be challenged MP2: maximum manufacturer's speed with show that value of acceleration = 19.0 m s^{-1} <u>Example of calculation</u> $v^2 = 0^2 + 2 \times 2.8$ m $s^{-2} \times 60$ m $v = 18.3$ m s^{-1}	3
11(c)	• Air resistance increases with speed so acceleration decreases (at higher speeds) • The car could brake with greater negative acceleration/force than the positive acceleration/force	(1) (1)	Ignore references to the mass of the car Accept friction for air resistance	2

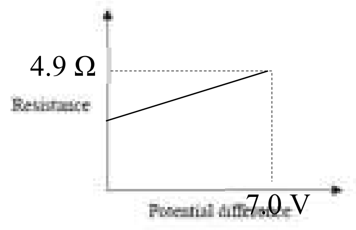
(Total for Question 11 = 7 marks)

Question Number	Acceptable answers	Additional guidance	Mark
12(a)	• Use of efficiency = output energy / input energy **(1)** • With energy output = load × change in height **(1)** • Energy input = IVt **(1)**	May be answered in terms of power For MP1 & MP2 accept electrical energy for energy input and work done/GPE for energy output Answers can be in terms of headings from table or cell numbers or values <u>Example of calculation</u> ΔE_{grav} = 4.00 N × 0.825 m = 3.30 J W = 2.1 A × 4.3 V × 2.19 s = 19.8 J Efficiency = $\frac{3.30\text{ J}}{19.8\text{ J}}$ = 0.167	**3**
12(b)	**Max 5** • The time is too short to be measured by a stop watch **Or** there is reaction time. **(1)** • Another variable could have been controlled **(1)** • Repeats should have been taken and a mean calculated **(1)** • Identifies that there is an anomaly (at about 5 N) that has not been checked/repeated **(1)** • Smaller weight intervals (around 6 N) to identify the maximum **Or** plot/take more data points around 6 N. **(1)** • Don't know where the maximum is so can't make a judgement that there is a maximum efficiency at 6 N **(1)** • The conclusion ignores the decline after 6 N (so is incomplete) **(1)**	MP2 need to specify a variable e.g. current or p.d.	**5**

(Total for Question 12 = 8 marks)

Question Number	Acceptable answers		Additional guidance	Mark
13(a)	• Use of moment = force × perpendicular distance • Use of clockwise moments = anticlockwise moments • Position of centre of gravity = 27 cm from base	**(1)** **(1)** **(1)**	MP1 not awarded if cos θ not used or sin θ not used <u>Example of calculation</u> $(18.5 \text{ kg} \times 9.81 \text{ N kg}^{-1}) \times x \cos \theta = 50 \text{ N} \times 0.97 \text{ m} \times \cos \theta$ $x = 0.27$ m	**3**
13(b)(i)	• Use of cos θ = vertical force ÷ applied force • Answer 55 N	**(1)** **(1)**	<u>Example of calculation</u> $\cos \theta = 50 \text{ N} \div F$ $F = 55.2$ N	**2**
13(b)(ii)	• Correct use of trigonometrical function to determine force in direction of motion • Use of $W = Fs$ **and** $P = W/t$ **Or** use of $v = s/t$ **and** $P = Fv$ • $P = 83$ W	**(1)** **(1)** **(1)**	MP3 allow ecf from (b)(i) <u>Example of calculation</u> $F = 55.2 \text{ N} \times \sin 25° = 23.3 \text{ N}$ $P = \frac{23.3 \text{ N} \times 15 \text{ m}}{4.2 \text{ s}}$ $= 83.2$ W	**3**

(Total for Question 13 = 8 marks)

Question Number	Acceptable answers		Additional guidance	Mark
14(a)	• Use of $R = V/I$ using pair of points from the graph • $R = 4.9\ \Omega$	**(1)** **(1)**	<u>Example of calculation</u> $R = 7.00\ \text{V} / 1.44\ \text{A}$ $R = 4.86\ \Omega$	**2**
14(b)	• Calculated resistance point plotted correctly at (4.9 Ω, 7.0 V) • Resistance increases (constantly) with potential difference • Positive intercept with y-axis (less than value from (a))	**(1)** **(1)** **(1)**	 MP3 conditional on MP2 being awarded.	**3**

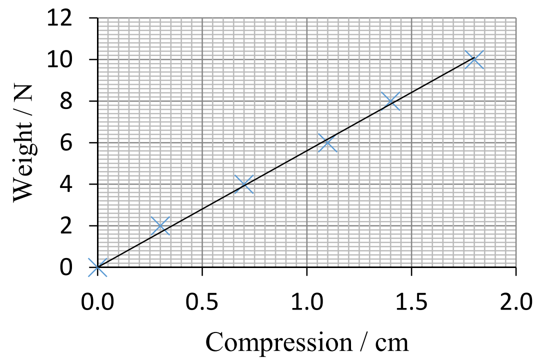
Question Number	Answer	Additional guidance	Mark
***14(c)**	This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning. Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning. The following table shows how the marks should be awarded for structure and lines of reasoning <table><tr><td>Number of indicative points seen in answer</td><td>Number of marks awarded for indicative points</td></tr><tr><td>6</td><td>4</td></tr><tr><td>5-4</td><td>3</td></tr><tr><td>3-2</td><td>2</td></tr><tr><td>1</td><td>1</td></tr><tr><td>0</td><td>0</td></tr></table> **Indicative content** • (As *V* increases) acceleration/velocity/energy of electrons increases • greater energy transfer in collisions with lattice / ions • increasing the temperature of metal/filament/ions • amplitude of vibrations of lattice/ ions increases • collision (rate) between lattice /ions and electrons increases **Or** shorter distance between collisions **Or** greater chance of collision • due to the increase in resistance, current doesn't increase in proportion to potential difference **Or** due to the increase in resistance the ratio of I/V decreases	The following table shows how the marks should be awarded for structure and lines of reasoning <table><tr><td></td><td>Number of marks awarded for structure and lines of reasoning</td></tr><tr><td>Answer shows a coherent and logical structure with linkage and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr><tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr><tr><td>Answer has no linkage between points and is unstructured</td><td>0</td></tr></table> Accept charge carriers for electrons and only penalise once for omission of charge carriers or lattice ions **Linkage marks** <table><tr><td>**Number of indicative content points awarded**</td><td>**Possible linkage marks**</td></tr><tr><td>**0, 1**</td><td>**0**</td></tr><tr><td>**2, 3**</td><td>**1**</td></tr><tr><td>**4, 5, 6**</td><td>**2**</td></tr></table> **MP1 don't award for 'increased rate of flow'** **MP2 to award mark there must be the idea of increased/greater energy transfer between electrons and ions**	**6**

(Total for Question 14 = 11 marks)

Question Number	Acceptable answers		Additional guidance	Mark
15(a)(i)	• Use of $\lambda = h/p$ **and** $v = f\lambda$ • Momentum of photon = 3.3×10^{-27} (N s)	(1) (1)	Example of calculation Momentum of photon = $p = hf/c$ $= 6.63 \times 10^{-34}$ J s $\times 1.5 \times 10^{15}$ Hz $\div 3.00 \times 10^{8}$ m s^{-1} $= 3.315 \times 10^{-27}$ N s	2
15(a)(ii)	• Momentum transfer = 6.6×10^{-27} (N s)	(1)	Ecf momentum from (i) in parts (a)(ii) and (c)	1
15(b)(i)	• Use of $hf = \varphi + \frac{1}{2} mv^2_{max}$ • Use of $E_K = \frac{1}{2} mv^2$ • $v = 8.4 \times 10^5$ (m s^{-1})	(1) (1) (1)	Example of calculation $hf = \varphi + \frac{1}{2} mv^2_{max}$ $hf = 6.63 \times 10^{-34}$ J s $\times 1.5 \times 10^{15}$ Hz $= 9.95 \times 10^{-19}$ J $hf - \varphi = 9.95 \times 10^{-19}$ J $- 6.7 \times 10^{-19}$ J $= 3.25 \times 10^{-19}$ J 3.25×10^{-19} J $= \frac{1}{2} \times 9.11 \times 10^{-31}$ kg $\times v^2$ $v = 8.4 \times 10^5$ m s^{-1}	3
15(b)(ii)	• Use of $p = mv$ • Momentum of photoelectron = 7.7×10^{-25} N s	(1) (1)	Example of calculation $p = 9.11 \times 10^{-31}$ kg $\times 8.4 \times 10^5$ m s^{-1} Momentum of photoelectron = 7.68×10^{-25} N s MP2: Using show that value $p = 7.3 \times 10^{-25}$ N s	2
15(c)	An explanation that refers to the following points: • the change in momentum of the graphene oxide is the same as the change in momentum of the photoelectron • so the (change in) momentum is much larger for the photoelectron than for the reflected photon	(1) (1)	Accept converse statement and answer that is consistent with candidate's values in (a) and (b)	2

(Total for Question 15 = 10 marks)

<table>
<tr><th>Question Number</th><th>Acceptable answers</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>16(a)(i)</td><td>Processing of data to calculate change in length (1)
Axes with labels & units (accept force for weight) (1)
Scales (1)
Plots (1)
Line of best fit (1)

<table>
<tr><th>Weight/ N</th><th>Compression/ cm</th></tr>
<tr><td>0.00</td><td>0.0</td></tr>
<tr><td>2.00</td><td>0.3</td></tr>
<tr><td>4.00</td><td>0.7</td></tr>
<tr><td>6.00</td><td>1.1</td></tr>
<tr><td>8.00</td><td>1.4</td></tr>
<tr><td>10.00</td><td>1.8</td></tr>
</table></td><td>

MP2: only award for a graph of weight against compression. Units may be in m or cm for compression. Allow paper to be landscape

MP3: scales only in 1,2,4,5 and must cover at least half of paper

MP4: a 2 mm square tolerance, check all points</td><td>5</td></tr>
<tr><td>16(a)(ii)</td><td>• States that best fit line is through the origin (1)
• So it fits Hooke's law because extension is proportional to force (1)
• Uses corresponding values from best fit line from (a)(i) to determine gradient (1)
• Spring constant = 10.0 N / 0.0176 m = 568 (N m^{-1}) (which, 1 s.f., is the stated answer) (1)</td><td>If plunger position plotted in (a)(i) then only MP2 may be awarded for attempt at gradient

MP3: values selected from at least half way along line or a triangle using over half the line is used

MP4: conditional on MP3 and allow any value that rounds to 1 sf as 600</td><td>4</td></tr>
</table>

16(b)	• Use of $\Delta F = k\Delta x$ **(1)** • Use of $\Delta E_{el} = ½ F\Delta x$ **(1)** • Use of $E_k = ½ mv^2$ **(1)** • $v = 6.7\ \text{m s}^{-1}$ to $6.8\ \text{m s}^{-1}$ **(1)**	<u>Example of calculation</u> $\Delta F = k\Delta x = 610\ \text{N m}^{-1} \times 0.054\ \text{m} = 32.94\ \text{N}$ $\Delta E_{el} = ½ F\Delta x = ½ \times 32.94\ \text{N} \times 0.054\ \text{m} = 0.90\ \text{J}$ $E_k = ½ mv^2$ so $0.90\ \text{J} = ½ \times (0.0041 + 0.0354)\ \text{kg} \times v^2$ $v = 6.75\ \text{m s}^{-1}$	**4**
16(c)	Work may be done against friction (by the spring/marble) **Or** KE is gained by the spring **Or** GPE gained by the piston **and** marble **Or** the light gate must be above the launch position so the marble is already accelerating downwards **Or** statement of friction between two specified parts in launch system **(1)**		**1**

(Total for Question 16 = 14 marks)