# Mark Scheme (Results)

## October 2020

Pearson Edexcel GCE
In Physics (8PH0)
Paper 1: Core Physics 1

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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 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** micrometer screw gauge (has a resolution of 0.01mm, less than the thickness of a piece of paper) | **1** |
| | Incorrect Answers:<br>**A** - measuring tape (has a resolution of 1mm, greater than the thickness of a sheet of paper)<br>**C** - ruler (has a resolution of 1mm, greater than the thickness of a sheet of paper)<br>**D** - vernier calipers (has a resolution of 0.1mm, approximately the same as the thickness of a sheet of paper) | |
| **2** | **B -** mgy, $E_P = mg\Delta h$, correct distance (vertical) | **1** |
| | Incorrect Answers:<br>**A** – incorrect distance (horizontal)<br>**C** – incorrect distance (horizontal + vertical)<br>**D** – incorrect distance (length of slope) | |
| **3** | **C** | **1** |
| | Incorrect Answers:<br>**A** – incorrect normal force direction<br>**B –** incorrect normal force direction and frictional force direction<br>**D –** incorrect frictional force direction | |
| **4** | **D** | **1** |
| | Incorrect Answers:<br>**A** – both sections of graph incorrect<br>**B** – both sections of graph incorrect<br>**C** – second section of graph incorrect | |
| **5** | **B** momentum | **1** |
| | Incorrect Answers:<br>**A** – scalar quantity<br>**C** – scalar quantity<br>**D** – scalar quantity | |
| **6** | **D** $\mathbf{kgm^2s^{-3}A^{-1}}$ | **1** |
| | Incorrect Answers:<br>**A** – correct units but J and C are not base units<br>**B** – correct units but J is not a base unit | |

| | | |
|---|---|---|
| | **C** – correct units but C is not a base unit | |
| **7** | **B** Equivalent R = $(1/R + 1/2R)^{-1}$ | **1** |
| | Incorrect Answers:<br>**A** – wrong expression<br>**C** – wrong expression<br>**D** – wrong expression | |
| **8** | **C** The diode starts to conduct when the potential difference is about 0.7 V. | **1** |
| | Incorrect Answers:<br>**A** – The diode has zero resistance when connected in the forward direction<br>**B** – The diode has zero resistance when connected in the reverse direction.<br>**D** – The diode stops conducting when the potential difference is about −0.7 V. | |

**(Total for Multiple Choice Questions = 8 marks)**

| Question Number | Acceptable answers | Additional guidance | Mark |
|---|---|---|---|
| **9(a)** | • Use of $v^2 = u^2 + 2as$ **(1)**<br>• With $v = 0$ and $a = -5.6$ **(1)**<br>• $u = 9.2$ m s$^{-1}$ **(1)**<br>**Or**<br>• Use of $a = \frac{F}{m}$ and $W = Fs$ **(1)**<br>• Use of $E_K = \frac{1}{2}mv^2$ **(1)**<br>• $u = 9.2$ m s$^{-1}$ **(1)** | Example of calculation<br>$0 = u^2 - 2 \times 5.6\ \text{ms}^{-2} \times 7.5\text{m}$<br>$u = 9.2$ m s$^{-1}$ | **3** |
| **9(b)** | • use of $mv$ **(1)**<br>• applies momentum conservation **(1)**<br>• $v = 17$ m s$^{-1}$ **(1)** | Example of calculation<br>2700 kg × 9.2 m s$^{-1}$ = 0 + 1500 kg × $v$<br>24840 kg m s$^{-1}$ = 1500 kg × $v$<br>$v$ = 16.6 m s$^{-1}$ | **3** |
| **9(c)** | • momentum not conserved as external force acts **(1)**<br>• friction from the road **(1)** | | **2** |

**(Total for Question 9 = 8 marks)**

| Question Number | Acceptable answers | Additional guidance | Mark |
|---|---|---|---|
| **10(a)** | • sum of moments (about any point) is zero **(1)**<br>**Or** resultant moment is zero (about any point)<br><br>• sum of the forces (in any direction) is zero<br>**Or** resultant force is zero (in any direction) **(1)** | | **2** |
| **10(b)(i)** | • shows clockwise moment = anticlockwise **(1)** | <u>Example of calculation</u><br><br>M.2 = 2M.1 | **1** |
| **10(b)(ii)** | • Moment of 3M associated with 1 **(1)**<br><br>• Takes moments around suspension **(1)**<br><br>• crow at A and owl at B **(1)**<br><br>Alternative scheme for MP2 and MP3:<br><br>• Show that, without the extra birds, it balances **(1)** | <u>Example of calculation</u><br><br>3M.1 + x.2 = M.3 + y.1<br><br>2x = y<br><br>So y must be an owl and x the crow | **3** |

| | | | |
|---|---|---|---|
| | • So added birds must be crow at A and owl at B, as in part (i) **(1)** | | |

**(Total for Question 10 = 6 marks)**

| Question Number | Acceptable Answer | Additional guidance | Mark |
|---|---|---|---|
| **11(a)** | • $I = 1.5 / (3 + 0.5)$ **(1)** | Or ref to cells<br>eg $I = 1.5 / (3 + A2)$ | **1** |
| **11(b)** | • $P = 0.30^2 \times 2.0$ **(1)** | Or ref to cells<br>eg $P = (B5)^2 \times A5$ | **1** |
| **11(c)** | • use smaller increments for resistance **(1)**<br>• around area of peak **(1)** | | **2** |

**(Total for Question 11 = 4 marks)**

| Question Number | Acceptable answers | Additional guidance | Mark |
|---|---|---|---|
| 12(a) | • connect thermistor to an ohmmeter to measure its resistance **(1)**<br>• Use a water bath eg beaker of water and immerse the thermistor **(1)**<br>• measure the temperature of the water using a thermometer **(1)**<br>• vary temperature and measure the resistance at fixed intervals **(1)**<br>• Thermometer held in retort stand to make beaker stable **Or** Leads clamped to make beaker stable **(1)**<br>• detailed point such as stir water **(1)** | alt based on ammeter/voltmeter combination<br>alternative methods eg vary *T* by using boiling water from a kettle and allow to cool<br>alternative safety: plenty of space around apparatus **Or** Safety glasses in case of splashes stand **Or** heatproof mat as boiling water<br>alternative detail: ensure eye level with thermometer **Or** adjust ohmmeter to give maximum sig fig without final figure varying randomly **Or** allow time for thermistor to reach water temperature **Or** keep thermometer and thermistor close to one another | **6** |

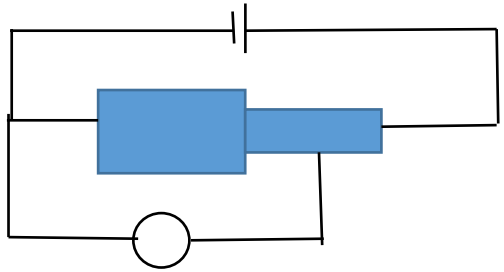
| | | | |
|---|---|---|---|
| **12(b)** | • resistance values have been taken every $10^{o}$ take more values say at 25 $^{o}$C and 35 $^{o}$C when *R* is changing more **(1)**<br>• Widen the range – can find *R* up to 100 $^{o}$C ie boiling water Or decrease *t* below room temperature by adding ice **(1)**<br>• Repeat experiment measuring *R* at the same temperatures then average *R*'s **(1)** | | **2Max** |
| **12(c)** | • Increased temperature causes more energy transfer to lattice ions / atoms **(1)**<br>• More charge carriers released / available **(1)**<br>• $I = nAvq$, so relative increase in $I$ **(1)**<br>• Reference to $R = V / I$ to justify decrease in $R$ **(1)** | Or reverse argument | **4** |

**(Total for Question = 12 marks)**

| Question Number | Acceptable answers | Additional guidance | Mark |
|---|---|---|---|
| **13a** | • Efficiency shouldn't have any units<br>**Or** efficiency should be a ratio of energies<br>**Or** efficiency should be a ratio of powers<br>**Or** number < 1 | | **1** |
| **13b** | • Quote $P = E/t$ **(1)**<br>• (k)W is unit of $P$ and h unit of $t$ so equivalent to $E$ **(1)** | | **2** |
| **13c** | • Use of Efficiency = useful energy output/energy input **(1)**<br>• Uses Energy input is power (kW) × time (h) **(1)**<br>• Efficiency = 0.87 **(1)** | <u>Example of calculation</u><br>$\text{Efficiency} = \frac{22\ \text{kWh}}{3.6\ \text{kW} \times 7\text{h}}$<br>Efficiency = 0.873 | **3** |

| Question Number | Acceptable answers | Additional guidance | Mark |
|---|---|---|---|
| **13d** | • converts battery input to a cost **(1)**<br>• comparison of petrol and electric cost for same range **Or** comparison of petrol and electric range for same cost **(1)** | Example of calculation<br>Cost of charging the battery = 3.6 kW ×7 h× 13 p<br>= £3.28<br>This is a cost per km of $\frac{3.28}{129}$ = 2.54 p<br>**Or** use of website figures: 0.195 kW h x 13 p/kW h = 2.54 p.<br>Petrol car: cost per km is $\frac{1.20}{21}$ = 5.71 p<br>Alternative: to calculate cost for 129 km<br>£3.276 for electric and £7.36 for petrol | **2** |
| **13e** | • no exhaust particulates **Or** no lead emission **Or** less carbon dioxide emission **Or** less greenhouse gases **Or** no polluting gases | | **1** |
| **13f** | • use of $E_k = ½ mv^2$ **(1)**<br>• use of $P = E/t$ **(1)**<br>• power required is 51 kW, less than engine power so it does have enough power **(1)** | Example of calculation<br>$E_k = \frac{1}{2}$1500 kg $28^2$ (m $s^{-1}$)$^2$ = $5.88\times10^5$ J<br>$P = 5.88\times10^5$ J / 11.5 s = 51.1 kW | **3** |

**(Total for Question 13 = 12 marks)**

| Question Number | Acceptable answers | Additional guidance | Mark |
|---|---|---|---|
| **14a** | • cell connected to both ends of paper with correct polarity **(1)**<br>• voltmeter with one end connected to 0V end of paper and other to halfway along narrow strip of paper **(1)** |  | **2** |

***14b**

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 indicative content.

- Use of $R = \rho l/A$
- the wider section will be half the resistance of the narrow section
- The p.d. will be divided into 0.5V across wide section and 1.0V across the narrow section
- The potential will vary linearly along each resistance section (as $R$ is proportional to $l$)
- This is because current is constant throughout length
- When the voltmeter is across the whole length it will read the p.d. across the cell/ 1.5V
  **Or** when the voltmeter terminals are together it will read 0 V

| IC points | IC mark | Max linkage mark available | Max final mark |
|---|---|---|---|
| **6** | 4 | 2 | **6** |
| **5** | 3 | 2 | **5** |
| **4** | 3 | 1 | **4** |
| **3** | 2 | 1 | **3** |
| **2** | 2 | 0 | **2** |
| **1** | 1 | 0 | **1** |
| **0** | 0 | 0 | **0** |

**6**

**(Total for Question = 8 marks)**

| Question Number | Acceptable answers | Additional guidance | Mark |
|---|---|---|---|
| **15(a)** | • measure distance from grating to screen $l$ and from centre to dot $x$ **(1)**<br>• use $\tan\theta = x / l$ to determine $\theta$ **(1)** | | **2** |
| **15(b)** | • Axes with labels **(1)**<br>• scales **(1)**<br>• plots **(1)**<br>• line of best fit **(1)** | **MP2**: scales only in 1,2,4,5 and must cover at least half of paper<br>**MP3**: a 2 mm square tolerance, check all points | **4** |
| **15(c)** | • calculation of a gradient **(1)**<br>• use gradient = $d/\lambda$ **(1)**<br>• use d = 0.001 / 300 **(1)**<br>• wavelength = $6.3 \times 10^{-7}$ m **(1)** | <u>Example of calculation</u><br>$\text{gradient} = \frac{4.0}{0.76} = 5.26$<br>$\frac{0.001}{300} = 5.26 \times \lambda$<br>wavelength = $6.3 \times 10^{-7}$ m | **4** |

**(Total for Question 15 = 10 marks)**

| Question Number | Acceptable answers | Additional guidance | Mark |
|---|---|---|---|
| **16(a)(i)** | • calculate difference in positions on y axis **(1)**<br>• use velocity = distance/0.1s **(1)** | might show this with a calculation:<br>v = (3.0 - 2.0) m / 0.1 s = 10 m $s^{-1}$ | **2** |
| **16(a)(ii)** | • this velocity is an average **(1)** | | **1** |
| **16a)(iii)** | • the horizontal distances between the points vary **(1)**<br>• the graph is not symmetrical around the vertical **Or** the graph is not parabolic **(1)**<br>• velocity-time graph is not straight line **Or** gradient of velocity-time graph is not constant **(1)**<br>• horizontal component of velocity should be constant **(1)**<br>• Acceleration in vertical direction should equal *g* **(1)** | 2 max from MP1,2,3<br>1 max from MP4,5 | **3Max** |
| **16(a)(iv)** | • attempt to find an area under graph **(1)**<br>• finds area up to *v* = 0 **(1)**<br>• height in range 2.80 - 2.95 m **(1)** | <u>Example of calculation</u><br>area of approximate triangle = ½ 0.5 × 11.5<br>= 2.88 m | **3** |

| | | | | |
|---|---|---|---|---|
| **16(b)** | • feathers will cause turbulent air flow **Or** feathers increase surface area | **(1)** | | **3** |
| | • this results in (high) drag force | **(1)** | | |
| | • horizontal velocities decrease **Or** vertical acceleration is no longer $g$ | **(1)** | | |

**(Total for Question 16 = 12 marks)**

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