edexcel
advancing learning, changing lives

# Mark Scheme (Results)

GCE

## GCE 08 Physics (6PH02/01)

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH

A PEARSON COMPANY

**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.

For example:

(iii) Horizontal force of hinge on table top

66.3 (N) or 66 (N) **and** correct indication of direction [no ue] ✓ **1**
[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.

**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.
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 cause the final calculation mark to be lost.
2.2 Incorrect use of case e.g. 'Watt' or 'w' will **not** be penalised.
2.3 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.
2.4 The same missing or incorrect unit will not be penalised more than once within one question.
2.5 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.
2.6 The mark scheme will indicate if no unit error penalty is to be applied by means of [no ue].

**3. Significant figures**

3.1 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.

**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.

4.6 Example of mark scheme for a calculation:

'Show that' calculation of weight

Use of L × W × H ✓

Substitution into density equation with a volume and density ✓

Correct answer [49.4 (N)] to at least 3 sig fig. [No ue] ✓
[If 5040 g rounded to 5000 g or 5 kg, do not give 3rd mark; if conversion to kg is omitted and then answer fudged, do not give 3rd mark]
[Bald answer scores 0, reverse calculation 2/3] **3**

Example of answer:

80 cm × 50 cm × 1.8 cm = 7200 $cm^3$

7200 $cm^3$ × 0.70 g $cm^{-3}$ = 5040 g

5040 × $10^{-3}$ kg × 9.81 N/kg

= 49.4 N

**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.

**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.

6.5 For a line mark there must be a thin continuous line which is the best-fit line for the candidate's results.

**Unit 2 6PH02_01**

| Question Number | Answer | Mark |
|---|---|---|
| **1** | C | **1** |
| **2** | B | **1** |
| **3** | D | **1** |
| **4** | B | **1** |
| **5** | A | **1** |
| **6** | C | **1** |
| **7** | B | **1** |
| **8** | C | **1** |
| **9** | B | **1** |
| **10** | D | **1** |
| | | |

| Question Number | Answer | Mark |
|---|---|---|
| **11** | p.d. is electrical energy(/coulomb) transferred between two points/electrical energy transformed/converted to other forms (1)<br><br>e.m.f is the energy(/coulomb) supplied to a circuit/given to the charge/energy output of the cell (1)<br><br>(full credit if wording implies emf as electrical energy source and pd as electrical energy sink)<br><br>If neither mark scored but reference to energy/charge is made scores 1 mark only | **2** |
| | **Total for question** | **2** |

| Question Number | Answer | Mark |
|---|---|---|
| **12** | Point A is half a wavelength from X (1)<br>At Y arrow drawn vertically downwards (1)<br>B marked at one of three positions of max displacement (1) | |
| | **Total for question** | **3** |

| Question Number | Answer | Mark |
|---|---|---|
| **13(a)** | A coulomb is an Amp sec or As (1)<br>Do not credit current × time | **1** |
| | | |
| **(b)** | $I_1$ = 10 mA (1)<br>$I_2$ = 5 mA (1)<br>$I_3$ = 30 mA (1) | **3** |
| | **Total for question** | **4** |

| Question Number | Answer | Mark |
|---|---|---|
| **14** | **QWC – Work must be clear and organised in a logical manner using technical wording where appropriate**<br><br>**Any three**<br>Reflected light is polarised<br>(1)<br>Polarised light vibrates/oscillates in one plane/direction<br>(1)<br>Polaroid filter only allows vibrations/oscillations in one direction/plane to pass through<br>(1)<br>When planes are parallel puddle appears light OR when perpendicular puddle<br>appears dark<br>(1)<br><br>(for 2nd and 3rd mark only one reference to vibrations/oscillations is needed)<br>(candidates who make no reference to puddle and answer in terms of two filters can score 2nd and 3rd marks only) | **Max 3** |
| | **Total for question** | **3** |

| Question Number | Answer | Mark |
|---|---|---|
| **15(a)** | n; number of charge carriers per unit volume OR number of charge carriers $m^{-3}$<br>OR charge carrier density (1)<br><br>*v*; drift velocity (of charge carriers) OR average velocity OR drift speed (1)<br><br>(accept free electrons or charge carriers throughout) | **2** |
| | | |
| **(b)** | Units of I and q A and A s OR C $s^{-1}$ and C (1)<br>Units of n $m^{-3}$ (1)<br>Units of v and A $m\ s^{-1}$ and $m^2$ (1) | **3** |
| | **Total for question** | **5** |

| Question Number | Answer | Mark |
|---|---|---|
| **16(a)** | Current in A is **equal to** current in B (1)<br>p.d across A is **less than** p.d. across B (1)<br>Resistance of A is **less than** the resistance of lamp B (1) | **3** |
| | | |
| **(b)** | Resistors in parallel have same p.d (1)<br>Identifies $P = V^2/R$ OR $P = VI$ and $I_A > I_B$ (1)<br>Uses this equation to state $P_A > P_B$.<br>**OR** bulb A brighter than bulb B. Consequent on 2nd marking point (1) | **3** |
| | **Total for question** | **6** |

| Question Number | Answer | Mark |
|---|---|---|
| **17 (a)(i)** | Node correctly placed (1) | **1** |
| | | |
| **(a)(ii)** | Arrow at Y moving up (1)<br>Arrow at Z moving down (1) | **2** |
| | | |
| **(b)** | Identifies a factor of 3 (1)<br>Fundamental frequency = 0.5 Hz (1) | **2** |
| | Total for question | **5** |

| Question Number | Answer | Mark |
|---|---|---|
| **18(a)** | Waves must have same frequency or wavelength (1)<br>Waves must have same amplitude (1)<br>Waves must be $180^{o}$, ½ wavelength, half a cycle, π radians apart or in antiphase (1) | **3** |
| | | |
| **(b)** | Noise of a vibrating object has a constant pitch/frequency (1)<br>Speech/sound varies in pitch and/or amplitude (1)<br>The idea of the difficult of matching a changing signal (1) | **3** |
| | **Total for question** | **6** |

| Question Number | Answer | Mark |
|---|---|---|
| **19(a)** | 5% of 60 W (is 3 W) (1)<br>Use of $I = P / 4\pi r^2$ (1)<br>OR<br>Uses $I = P / 4\pi r^2$ with 60 W<br>Finds 5% of this answer<br><br>Intensity = 0.038 W $m^{-2}$ (1)<br>(accept 0.04 W $m^{-2}$ ) | **3** |
| | | |
| **(b)** | **QWC – Work must be clear and organised in a logical manner using technical wording where appropriate**<br><br>**Any three**<br>Fluorescent lamp much more efficient OR filament lamp is less efficient(1)<br>Sensible attempt to process the values given (1)<br>Indicates that less than 25% of national power used for lighting (1)<br>Reduction in wasted energy as thermal energy (1)<br>Reduction in $CO_2$ emission or preserves fossil fuel resources (1)<br><br>(Just saying filament lamp is inefficient does not score 1st mark) | **Max 3** |
| | **Total for question** | **6** |

| Question Number | Answer | Mark |
|---|---|---|
| **20(a)** | Use of distance = speed × time (1)<br>Recognising distance travelled is twice the measurement or halves the time given (1)<br>Distance = 4.1 m (1)<br><br>**Example of calculation**<br>Distance = (330 m $s^{-1}$ × 25 × $10^{-3}$ s) ÷ 2<br>Distance = 4.125 m | **3** |
| | | |
| **(b)** | One pulse must return before the next one is sent<br>**OR**<br>So that time interval between transmitted and received pulses can be measured<br>**OR**<br>No overlap between pulses<br>**OR**<br>No interference between pulses | **1** |
| | **Total for question** | **4** |

| Question Number | Answer | Mark |
|---|---|---|
| **21(a)** | LED 1 colour green<br>LED 2 colour orange<br>LED 3 colour red All three correct | **1** |
| | | |
| **(b)** | Least energetic photon<br>Use of E = hf or hc/λ must see correct value of h (1)<br>Use of f = 4.41 ×( $10^{14}$) Hz or equivalent λ (1)<br>E = 2.92 × $10^{-19}$ J (1)<br>(E = 1.83 eV gets full credit)<br><br>**Example of calculation**<br>E = 6.63 × $10^{-34}$ J s × 4.41 × $10^{14}$ Hz<br>E = 2.92 × $10^{-19}$ J | **3** |
| | **Total for question** | **4** |

| Question Number | Answer | Mark |
|---|---|---|
| **22(a)** | **Plot of graph**<br>Check points, 4 correct 2 marks, 3 correct 1 mark<br>Line of best fit to include 0,0.6 and 0.52,0 (1) | **3** |
| | | |
| **(b)(i)** | Use of V = 0.43 V in P = VI (1) ecf values for incorrect best fit line<br>P = 0.17 W (1)<br><br>**Example of calculation**<br>P = 0.4 A × 0.43 V<br>P = 0.172 W | **2** |
| | | |
| **(b)(ii)** | Value of e.m.f. is when the current is zero (1)<br>No 'lost' volts OR no energy loss (1)<br>**OR**<br>E = V + Ir<br>I = 0, E = V | **2** |
| | | |
| **(b)(iii)** | Identifies current in circuit (1) ecf values for incorrect best fit line<br>Finds 'lost volts' (1)<br>r = 0.24 Ω (1)<br><br>**Example of calculation**<br>r = (0.52 V – 0.40 V) ÷ 0.50 A<br>r = 0.24 Ω | **3** |
| | | |
| **(c)** | Graph of similar shape as in (a) but initially above the first graph (1)<br>ecf values for incorrect best fit line<br><br>Finishing at 0.52 V, 0.00 A (1) | **2** |
| | **Total for question** | **12** |

| Question Number | Answer | Mark |
|---|---|---|
| **23(a)** | Energy of the photon is less than the work function (of lithium)<br>**OR** frequency of photons is below the threshold frequency (of lithium)<br>(1)<br><br>Work function is the minimum energy for electrons to be released<br>**OR** No electrons are emitted<br>**OR** no (electron) emission occurs (1)<br><br>'There is not enough energy for (electron) emission to occur' scores 1/2 | **2** |
| | | |
| **(b)** | Energy 1.8 eV current 0 (1)<br>Energy 3.8 eV current $2.0 \times 10^{-11}$ (1) | **2** |
| | | |
| **(c)(i)** | Use of $1.6 \times 10^{-19}$ (1)<br>Energy = $3.7 \times 10^{-19}$ J (1) | **2** |
| | | |
| **(c)(ii)** | Use of $hf = \varphi + ½ mv^2_{max}$ (1) ecf (c)(i)<br>KE = $4.4 \times 10^{-18}$ J (1)<br>Use of KE = ½ $mv^2$ (1)<br>Speed = $3.1 \times 10^6$ m $s^{-1}$ (1)<br><br>**Example of calculation**<br>KE = $4.8 \times 10^{-18}$ J - $3.68 \times 10^{-19}$ J = $4.4 \times 10^{-18}$ J<br>$v^2 = 2 \times 4.4 \times 10^{-18}$ J ÷ $9.11 \times 10^{-31}$ kg<br>v = $3.1 \times 10^6$ m $s^{-1}$ | **4** |
| | **Total for question** | **10** |