Pearson Edexcel

Mark Scheme (Results)

October 2018

Pearson Edexcel International Advanced Subsidiary Level
In Physics (WPH02)
Paper 01 Physics at Work

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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 C** A is not correct because C is not equivalent to the ampere B is not correct because C s is not equivalent to the ampere D is not correct because s C^{-1} is not equivalent to the ampere	**1**
2	**The only correct answer is B** A is not correct because it has an incorrect use of the factor of 2 C is not correct because it is an incorrect arrangement D is not correct because there is no factor of 2	**1**
3	**The only correct answer is C** A is not correct because frequency increases B is not correct because time period decreases D is not correct because wavelength decreases	**1**
4	**The only correct answer is D** A is not correct because this transition results from absorption of EM energy B is not correct because this transition results in emission of the lowest frequency C is not correct because this transition results from absorption of EM energy	**1**
5	**The only correct answer is A** B is not correct because this does not show total internal reflection C is not correct because this does not show total internal reflection D is not correct because this does not show total internal reflection	**1**
6	**The only correct answer is D** A is not correct because the change in displacement is downwards B is not correct because the change in displacement is downwards C is not correct because the change in displacement is downwards	**1**
7	**The only correct answer is A** B is not correct because an incorrect equation has been used C is not correct because the useful power output has been taken incorrectly to be 9.8 W	**1**

	D is not correct because an incorrect value for useful power output of 9.8 W has been used with the reciprocal of the correct equation	
8	**The only correct answer is B** A is not correct because current is the rate of flow of charge C is not correct because power is rate of energy transfer D is not correct because resistance is the ratio of potential difference to current	**1**
9	**The only correct answer is D** A is not correct because this does not show an increasing I with θ B is not correct because this does not show an increasing I with θ C is not correct because this shows zero current at θ=0℃	**1**
10	**The only correct answer is C** A is not correct because reflection is the correct answer B is not correct because diffraction is not relevant in this context D is not correct because reflection is the correct answer	**1**

Question Number	Answer	Mark
11(a)	waves (travelling) in opposite directions **Or** wave and reflected wave (1) (The waves meet and) superpose/interfere (1) producing nodes and antinodes **Or** producing points of zero/minimum amplitude and points of maximum amplitude (1)	**3**
11(b)	1.3 m (1) <u>Example of calculation</u> $\frac{2.6\text{ m}}{2} = 1.3\text{ m}$	**1**
	Total for question 11	**4**

Question Number	Answer		Mark
12(a)	Use of sum of e.m.f. = sum of p.d.s Use of $R = V/I$ r = 1.1 Ω <u>Example of calculation</u> $1.5\,\text{V} = 1.2\,\text{V} + 0.280\,\text{A} \times r$ $0.3 = 0.280r$ $r = 1.07\Omega$	(1) (1) (1)	**3**
12(b)	Use of $P = IV$ with V = 1.2 (V) **Or** Use of $P = I^2 R$ **and** $R = V/I$ with V = 1.2 (V) **Or** Use of $P = V^2/R$ **and** $R = V/I$ with V = 1.2 (V) Power = 0.34 W <u>Example of calculation</u> $P = 0.28\,\text{A} \times 1.2\text{ V}$ Power = 0.336 W	(1) (1)	**2**
	Total for question 12		**5**

Question Number	Answer	Mark
13(a)	**Either** Unpolarised – oscillations/vibrations in many/all/every direction (1) Polarised – oscillations/vibrations in single/one direction (1) which is perpendicular to the direction of energy transfer (1) **Or** Unpolarised – oscillations/vibrations in many/all/every plane (1) Polarised – oscillations/vibrations in single/one plane (1) which includes direction of propagation (1) (By either method, MP3 is dependent on MP2)	**3**
13(b)	Photograph B (no mark) Reflected light is (partially) polarised (1) Reflected light is not transmitted (by the filter) **Or** Reflected light is absorbed/blocked/stopped (by the filter) (1) (As the plane of polarisation of) reflected light is perpendicular to (the plane of polarisation of) the filter (1)	**3**
	Total for question 13	**6**

Question Number	Answer	Mark
14	Longitudinal wave (1) Compressions and rarefactions (1) Oscillations/vibrations parallel to the direction of wave travel (1) Progressive wave **Or** Named example of a longitudinal wave **Or** Description of compressions **and** rarefactions as areas of zero displacement **Or** Description of compressions as areas of high pressure **and** rarefactions as areas of low pressure **Or** Wavelength is the distance between adjacent compressions/rarefactions (1)	**4**
	Total for question 14	**4**

Question Number	Answer	Mark
15(a)	Mention of diffraction (of radiowaves) (1) When the wavelength is of comparable size to the hill **Or** wavelength is greater than the height of the hill (1) Use of $v = f\lambda$ with 3×10^{8} m s^{-1} (1) λ = 433 m (1) <u>Example of calculation</u> $3\times10^{8}\text{ms}^{-1} = 693\times10^{3}\text{s}^{-1}\lambda$ λ=433 m	**4**
15(b)	Use of Radiation flux = power per unit area (1) Use of Energy = Power $\times$ time (1) Energy = 7.5 $\times$ 10^{-7} J (1) <u>Example of calculation</u> $E = 8.3\times10^{-9}\text{Wm}^{-2}\times0.025\text{ m}^{2}\times3600\text{ s}$ E= 7.5 $\times$ 10^{-7} J	**3**
***15(c)**	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) UV frequency is greater (than radio frequency) (1) Reference to <u>photon</u> (1) (Photon) energy is proportional to frequency (1) (Electromagnetic waves with) a higher frequency/energy cause more ionisation **Or** UV is more ionising (1) (MP3 dependent on MP2)	**4**
	Total for question 15	**11**

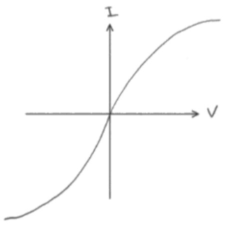
Question Number	Answer		Mark
16(a)	Waves are in antiphase **Or** Waves are out-of-phase by half a cycle **Or** Waves have a path difference of $\frac{\lambda}{2}$ Waves would destructively interfere	(1) (1)	2
16(b)(i)	Use of $\mu = \frac{v_1}{v_2}$ with c=3.0 × 10^8 (m s^{-1}) velocity = 2.0 × 10^8 m s^{-1} <u>Example of calculation</u> $1.5 = \frac{3 \times 10^8 \text{ms}^{-1}}{v}$ v = 2.0 × 10^8 m s^{-1}	(1) (1)	2
*16(b)(ii)	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) Path difference = 2.0 × 10^{-7} (m) **or** path difference = 2d This is equivalent to half a wavelength (of yellow light in oil) **or** 2d = $\frac{\lambda}{2}$ A path difference of half a wavelength is equivalent to a phase change of 180^0 (or vice versa) **Or** Both waves have undergone a phase change of 180^0 **Or** The waves have undergone the same phase change So the two waves are in phase (at the top of the oil) (and) interfere/superpose constructively	(1) (1) (1) (1) (1)	5
	Total for question 16		**9**

Question Number	Answer	Mark
17(a)	Photon(s) absorbed (1) **Or** Photon(s) transfer energy to electrons (And electron(s) released when) incident photon(s)/radiation/light has energy greater than the work function (1)	**2**
17(b)(i)	Calculates a gradient using at least half the graph (1) h = 6.3 × 10^{-34} J s (range 6.2 × 10^{-34} J s to 6.4 × 10^{-34} J s) (1) Example of calculation Gradient = $\frac{(2.0-0)\times 10^{-19}\,\text{J}}{(7.2-4.0)\times 10^{14}\,\text{Hz}} = 6.3\times 10^{-34}\,\text{J s}$	**2**
17(b)(ii)	(This is called the) threshold frequency (1) Lowest/minimum frequency (of light/photons incident on a metal) that will cause electron(s) to be emitted (from surface) **Or** the frequency of (light/photons) that will cause electron(s) to be emitted (from the surface of a metal) with zero kinetic energy (accept only just emitted) (1)	**2**
17b(iii)	Uses $hf_0 = \varphi$ (1) **Or** use of $hf = \varphi + \frac{1}{2}mv^2_{max}$ with corresponding values from graph Conversion of J to eV (1) φ = 1.5 to 1.7 (eV) (1) Example of calculation $\varphi = 6.63\times 10^{-34}\,\text{J s}\times 4.0\times 10^{14}\,\text{Hz}$ $\varphi = 2.65\times 10^{-19}$ J $\phi = \frac{2.65\times 10^{-19}\,\text{J}}{1.6\times 10^{-19}\,\text{J eV}^{-1}} = 1.7\,\text{eV}$	**3**
	Total for question 17	**9**

Question Number	Answer	Mark
18(a)	Use of $V=IR$ (1) Use of $R=\frac{\rho l}{A}$ (1) ρ = 440 Ω m (1) <u>Example of calculation</u> $R=\frac{12\text{ V}}{8.5\times10^{-3}\text{ A}}=1412\ \Omega$ $\rho=\frac{1412\ \Omega\times0.25\text{ m}^2}{0.80\text{ m}}=441\ \Omega\text{ m}$	**3**
18(b)	States a value for the resistivity of a layer (1) Makes a comparison between the resistivity of layers (1) (Between topsoil and subsoil) the resistivity decreases slowly indicating the varying depth **or** incline of the subsoil **Or** (At 5 m) resistivity increases suddenly indicating the constant depth of bedrock (1)	**3**
18(c)(i)	Potential divider **Or** resistance is proportional to length (1) so V is proportional to l (1) V = 3 V (1)	**3**
18c(ii)	**Max 1** Cross sectional area will be more constant (over a small length) Less variation in resistance/resistivity/material (over a shorter length) Eliminates contact resistance of electrodes with the ground (Second arrangement) combines both methods so two values of resistivity can be calculated and compared (1)	**1**
	Total for question 18	**10**

<table>
<tr><th>Question Number</th><th>Answer</th><th></th><th>Mark</th></tr>
<tr><td>19(a)</td><td>
<table>
<tr><td colspan="3">B is brighter and A is dimmer</td></tr>
<tr><td>$P = \frac{V^2}{R}$</td><td>$P = I^2R$</td><td>$P = VI$</td></tr>
<tr><td>Resistance of parallel combination decreases</td><td>Resistance in parallel/circuit decreases</td><td>Resistance in circuit decreases</td></tr>
<tr><td>p.d. across B increases Or p.d. across A (or C) decreases</td><td>Current (in circuit/B) increases</td><td>Current (in circuit) increases</td></tr>
<tr><td>p.d. across A = p.d. across C</td><td>Current shared (equally) between A and C</td><td>Current shared (equally) between A and C</td></tr>
<tr><td colspan="3">(So) A and C are the same brightness (as each other)</td></tr>
</table>
</td><td>(1)
(1)
(1)
(1)
(1)
(1)</td><td>6</td></tr>
<tr><td>19(b)(i)</td><td>Correct curve in + + section

Symmetrical negative curve (consistent with their ++ curve)


</td><td>(1)

(1)</td><td>2</td></tr>
<tr><td>19(b)(ii)</td><td>Temperature increases with increasing current or potential difference

(with temperature increase) there is an increase in ion/atom vibrations

Greater rate of collisions between electrons and ions/atoms/lattice (causing an increase in resistance)

The rate of increase of current with p.d. decreases</td><td>(1)

(1)

(1)

(1)</td><td>4</td></tr>
<tr><td></td><td>Total for question 19</td><td></td><td>12</td></tr>
</table>

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