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Mark Scheme June 2009

GCE

GCE 08 Physics (8PH01)

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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)**
	Total for question	**1**

Question Number	Answer	Mark
2	D	**(1)**
	Total for question	**1**
Question Number	Answer	Mark
3	B	**(1)**
	Total for question	**1**
Question Number	Answer	Mark
4	B	**(1)**
	Total for question	**1**
Question Number	Answer	Mark
5	C	**(1)**
	Total for question	**1**
Question Number	Answer	Mark
6	A	**(1)**
	Total for question	**1**
Question Number	Answer	Mark
7	B	**(1)**
	Total for question	**1**
Question Number	Answer	Mark
8	D	**(1)**
	Total for question	**1**
Question Number	Answer	Mark
9	A	**(1)**
	Total for question	**1**
Question Number	Answer	Mark
10	A	**(1)**
	Total for question	**1**

Question Number	Answer	Mark
11	Use of $V = IR$ to find total resistance **or** terminal p.d.	**1**
	Subtraction of resistance **or** p.d.s	**1**
	$r = 8.2\ \Omega$ (accept $8\ \Omega$)	**1**
	OR see $E = I(R+r)$	**1**
	Substitution of values into equation	**1**
	$r = 8.2\ \Omega$ (accept $8\ \Omega$)	**1**
	Example of answer	
	Total $R = 1.5\ \text{V} \div (17 \times 10^{-3}\ \text{A}) = 88.2\ \Omega$	
	$r = 88.2 - 80 = 8.2\ \Omega$	
	Total for question	**3**

Question Number	Answer	Mark
12	Attempt to use $I = Q / t$	**1**
	use of $e = 1.6 \times 10^{-19}$	**1**
	$I = 2.8 \times 10^{6}\ \text{A}\ [\text{C s}^{-1}]$	**1**
	[omit e gives answer 1.73×10^{25} scores 1]	
	Example of answer	
	$I = (2.6 \times 10^{26} \times 1.6 \times 10^{-19}\ \text{C}) \div 15\ \text{s}$	
	$I = 2.77 \times 10^{6}\ \text{A}$	
	Total for question	**3**

Question Number	Answer	Mark
13(a)	Diffraction is the spreading out of the wave	1
	As it passes through an aperture/around an obstacle	1
(b) (i)	Electrons can behave as waves **OR** electrons have wave like properties **OR** electrons act like wave particles	1
(ii)	$\lambda \approx$ spacing/gap between atoms **OR** the size of the atoms **OR** spacing/gap in the graphite	1

	Total for question	4

Question number	Answer	Mark
14(a)	Doppler	1
(b)	**MAX 3** **Ambulance moving towards**, higher frequency/pitch (1) Wavelength shorter/waves bunch together (1) **Ambulance moving away**, lower frequency/pitch (1) wavelength increased/waves spread out (1) (wavelength marks may be awarded on a diagram)	
		Max 3
(c)	Reference to a higher/lower frequency/wavelength/pitch scores 1 Change in frequency is greater **OR** even higher/ lower frequency **OR** range of frequencies greater scores 2	
		2
	Total for question	**6**

Question Number	Answer	Mark
15(a)	Use of $V=IR$ V = 3.0 V	**1** **1**
(b)	pd across 30 Ω resistor = 6.0 V ecf their answer (a) I_2 = 6.0/30 = 0.20 A	**1** **1**
(c)	I_1 = 0.60 – 0.20 = 0.40 A R = 15 Ω full ecf their answer for I_2 and their V across 30 Ω	**1** **1**
	Total for question	**6**

Question Number	Answer	Mark
16	The answer must be clear and organised in a logical sequence • Different currents / current divides in parallel circuit(1) • • Same potential difference/voltage across each lamp (1) • • Use of $P = V^2 / R$ **OR** $P = VI$ if identified $I_A < I_B$ (1) • Leading to high resistance, smaller power (1) • • lamp B will be brighter/ lamp A dimmer (1) • • Each electron loses the same energy (1) • There are more electrons/sec in B (1) • Hence greater total energy loss /sec in B (1)	
		Max 5
	Total for question	**5**

Question Number	Answer	Mark
17 (a)	A statement which implies only certain energies are allowed e.g. Allowed/possible energy of atom/electron (in an atom) Discrete energy of an atom/electron One of the energies of the atom/electron Energy an atom/electron can have	**1**
(b)	Photon is a (discrete) package/packet/quantum of (electromagnetic) energy/particle of light	**1**

(c)	(energy of) E_2 – (energy of)E_1	**1**
(d)	See $E = h\,c\,/\,\lambda$ **OR** use of $v = f\lambda$ Substitution into $E = h\,c\,/\,\lambda$ **OR** use of $E = hf$ $E = 3.14 \times 10^{-19}$ J or 1.96 eV **Example of answer** $E = (6.63 \times 10^{-34}$ Js $\times 3 \times 10^{8}) \div 6.33 \times 10^{-7}$ m $E = 3.14 \times 10^{-19}$ J	**1** **1** **1**
	Total for question	**6**

Question Number	Answer	Mark
18	Addition of words (order essential) photon metal energy (allow mass, charge, momentum) (photo)electron work function (of the metal)	 **1** **1** **1** **1** **1**
	Total for question	**5**

Question Number	Answer	Mark
19(a)	Ray drawn along edge of prism (labelled X) **(**ignore a reflected ray)	**1**
(b)(i)	$n = 3 \times 10^{8} \div 1.96 \times 10^{8}$ n = 1.53 (no unit, ue if one given)	**1** **1**
(b)(ii)	Use of sin (critical angle) = 1/ n **OR** use of sin i/sin r = v_1/v_2 = n c = 41°	**1** **1**
(c)	Red light: refraction towards normal at first face but less than refraction for blue light Refracts into air at second face with angle in air > angle in glass	**1** **1**
	Total for question	**7**

Question Number	Answer	Mark
20(a)	The answer must be clear, organised in a logical sequence and uses specialist vocabulary Interference (pattern) produced / superposition occurs/ standing wave formed Maxima related to constructive interference/antinode **and/or** minima related to destructive interference/node Maxima/antinode formed where the waves are in phase / path difference nλ Minima/node formed where the waves are in antiphase / path difference = (n+½)λ [out of phase is not sufficient]	**1** **1** **1** **1**
(b)(i)	Distance between adjacent maxima = λ/2 Wavelength = 0.1 m	**1** **1**
(b)(ii)	Use of $v = f\lambda$ with their λ from (b)(i) Speed = 330 m s^{-1} ecf their λ **Example of answer** $v = 3300 \times 0.1$ $v = 330$ m s^{-1}	**1** **1**
(c)(i) and (ii)	(mark (i) and (ii) as one section (minima never zero) because there is not complete cancellation/overall displacement is not zero/ not total destructive interference Because the waves have different amplitudes/amplitude decreases with distance **OR** energy loss due to reflection or spreading out	**1**

	OR reflection off other surfaces As the microphone moves towards the plate, the path difference decreases Amplitudes (of waves) get similar	**1** **1** **1**
	Total for question	**12**

Question Number	Answer	Mark
21(a)	<u>Effect of stretching wire</u> Refers to $R = \rho l / A$ Increasing length leads to increase in resistance Decreasing area leads to increase in resistance [must relate thinner to area] [last two points may be combined to give single statement, can score both marks]	 **1** **1** **1**
(b)	<u>Resistance calculation</u> Use of $R = \rho l / A$ × 8 R = 0.22 (Ω) [Omitting x8 gives R = 0.028 Ω scores 1] **Example of answer** $R = (9.9 \times 10^{-8}\ \Omega\ m) \times (8 \times 0.025\ m) \div 0.9 \times 10^{-7}\ m^2$ R = 0.22 Ω	 **1** **1** **1**
(c) **(i)**	<u>Relationship and increase in R</u> Attempts to substitute for $A = V/l$ in $R = \rho l / A$ $R = \rho l^2 / V$	 **1** **1**
(ii)	Any attempt to relate original resistance of gauge to 2.5^2 (possibly × 8, cm or m) Relates this to resistance associated with increase in length Change in resistance = $1.76 \times 10^{-3}\ \Omega$ **OR** Uses $V = lA$ to find new area Uses this A with new length to find new R Change in resistance = $1.76 \times 10^{-3}\ \Omega$ [if candidate assumes A constant and finds new R and ΔR = 0.001 Ω, score 1 mark] **Example of answer**	**1** **1** **1** **1** **1** **1**

	New $R = \left(\frac{2.51^2}{2.5^2} \times 0.22\right) - 0.22$ $\Delta R = 1.76 \times 10^{-3}\ \Omega$	
(d)	<u>Zigzag pattern</u> Each section of wire increases in length/gives a longer total length/long wire in small space Small change in length of gauge leads to larger change in resistance	**1** **1**
	Total for question	**13**

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