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Mark Scheme (Results)

June 2011

GCE Physics (6PH02) 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.

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 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.

Quality of Written Communication

- Indicated by QoWC in mark scheme. QWC – Work must be clear and organised in a logical manner using technical wording where appropriate.
- Usually it is part of a max mark, the final mark not being awarded unless the QoWC condition has been satisfied.

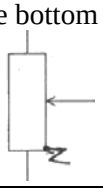
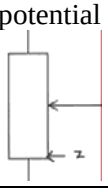
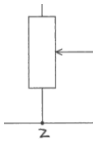
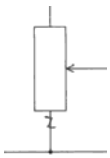
Question Number	Answer	Mark
1	A	**1**
2	D	**1**
3	C	**1**
4	A	**1**
5	A	**1**
6	A	**1**
7	B	**1**
8	C	**1**
9	A	**1**
10	B	**1**

Question Number	Answer		Mark
11(a)	Use of $Q = It$ Q = 450 C / A s Example of calculation Q = 15 000 A × 3.0 × 10^{-2} s Q = 450 C	**(1)** **(1)**	**2**
11(b)	Use of $R = \rho l/A$ Length of conductor = 24 (m) Height of statue = length – 1 m = 23 m *Assumption:* **ANY ONE** Included height of plinth. Conductor/wire doesn't carry on in ground Conductor/wire vertical/straight/parallel Example of calculation $l = \frac{RA}{\rho}$ $l = \frac{2.7 \times 10^{-3}\ \Omega \times 1.5 \times 10^{-4}\ \text{m}^2}{1.7 \times 10^{-8}\ \Omega\, m}$ l = 23.8 m Height of statue = 23.8 – 1 = 22.8 m	**(1)** **(1)** **(1)** **(1)**	**4**
11(c)	**ANY ONE** The idea that the lightning is attracted to /strikes/hits the conductor **OR** Lightning takes shortest path (from cloud) /strikes highest point **OR** Action of points	**(1)**	**1**
	Total for question 11		**7**

Question Number	Answer		Mark
12(a)(i)	Use of v = fλ with v = 3.00 x 10^8 (ms^{-1}) f = 4.57 × 10^{14} Hz (allow s^{-1}) example of calculation f = $\frac{3 \times 10^8 \text{ m s}^{-1}}{6.56 \times 10^{-7} \text{ m}}$ f = 4.57 × 10^{14} Hz	**(1)** **(1)**	**2**
12(a)(ii)	Correct use of 1(eV) = 1.6 × 10^{-19}(J) to convert eV to J or J to eV e.g. $\frac{3.03 \times 10^{-19}}{1.6 \times 10^{-19}}$ = 1.9 (eV) Transition **from** (-)1.5 (eV) **to** (-)3.4 (eV)	**(1)** **(1)**	**2**
12(b)	Wavelength increased or stretched /frequency decreased/red shift/ Doppler effect Galaxy is moving away (from us/sun)	**(1)** **(1)**	**2**
	Total for question 12		**6**

Question Number	Answer		Mark
13(a)	Use of $P = VI$ Current = 0.021 A Example of calculation I = $\frac{P}{V} = \frac{4.8}{230}$ = 0.021 A	**(1)** **(1)**	**2**
13(b)(i)	Use of $P = VI$ to justify (numbers or symbols) Examples $P = VI$, so W = V A **Or** V = JC^{-1}, A = C s^{-1} so V A = J C^{-1} x C s^{-1} = J s^{-1} = W **Or** 5 V × 0.1 A = 0.5 W	**(1)**	**1**
13(b)(ii)	Efficiency = $\frac{0.5}{4.8}$ (× 100) Efficiency = 10% or 0.1 Example of calculation Efficiency = $\frac{0.5}{4.8}$ × 100 Efficiency = 10.42 %	**(1)** **(1)**	**2**
13(b)(iii)	Energy/power converted/wasted/transferred/lost to thermal or heat (energy) **Or** Energy/power lost due to resistance (allow internal resistance)	**(1)**	**1**
	Total for question 13		**6**

Question Number	Answer		Mark
14(a)	*Transverse* Vibration/oscillation/displacement is perpendicular to direction of wave/energy travel (allow propagation or wave velocity for wave travel) *Longitudinal* Vibration/oscillation/displacement is parallel to direction of wave/ energy travel (allow in the same direction for parallel) Marks can be scored from a clearly labelled diagrams	**(1)** **(1)**	**2**
14(b)(i)	(Pulse) longitudinal Hammer moves horizontally OR parallel to (length of) rod Or Hammer causes compressions in rod	**(1)** **(1)**	**2**
14(b)(ii)	Use of speed = distance/time Use of either 2.4×10^{-4} s **OR** 2.4 m Speed = 5000 m s^{-1} (2500 (m s^{-1}) scores max 1/3 for use of v=d/t) (do not credit method using $v=f\lambda$) <u>Examples of calculation</u> Speed $= \frac{2.4 \text{ m}}{4.8 \times 10^{-4} \text{ s}}$ or $\frac{1.2 \text{ m}}{2.4 \times 10^{-4} \text{ s}} = 5000$ m s^{-1}	**(1)** **(1)** **(1)**	**3**
14(b)(iii)	Vibration/oscillation of (atoms/molecules/particles in) rod/metal	**(1)**	**1**
14(c)	**Max 3** • Idea of reflection (in rod) **OR** two waves travelling in opposite directions • Waves have same frequency /wavelength • Superposition (do not credit superimposition) • Nodes and antinodes produced. (marks can be scored from a labelled diagram)	**(1)** **(1)** **(1)** **(1)**	**3**
	Total for question 14		**11**

Question Number	Answer	Mark
15(a)(i)	Ammeter and voltmeter both correct **(1)**	**1**
15(a)(ii)	Z at the bottom of the potential divider **(1)** from  or  down to  eg 	**1**
15(b)(i)	Current =0.75 (A) (range 0.74 A – 0.76 A) **(1)** Use of $V = IR$ **(1)** Resistance = 13-14 Ω **(1)** (incorrect current e.g. use of tangent, scores 1 max for use of $V = IR$) <u>Example of calculation</u> $R = \frac{V}{I} = \frac{10\ V}{0.75\ A} = 13.3\Omega$	**3**
***15(b)(ii)**	(QWC- Work must be clear and organised in a logical manner using technical wording where appropriate.) **Max 3** Initially or until about 4 V, I α V/Ohmic conductor **(1)** (Increasing the) <u>current</u> causes heating effect /temperature rise **(1)** Resistance increases OR increases lattice/ion/atoms vibrations **(1)** Rate of increase of current (with potential difference) decreases **(1)**	**3**
15(c)(i)	Reading current values at 4 V of <u>both</u> 0.3 (A) and 0.5 (A) **(1)** (power of 10 error allowed eg 3(A)and 5 (A) seen) Current = 0.8 A **(1)** (allowing for ± 0.1 mm square tolerance, accept range 0.76A to 0.84A)	**2**
15(c)(ii)	p.d. across R = 8 V **(1)** $R = \frac{8\ V}{0.8\ A} = 10\ \Omega$ (allow ecf from part (c)(i) for the value of I substituted) **(1)** (accept answers in range 9.52 Ω to 10.53 Ω using range for I)	**2**
15(c)(iii)	Resistance of P greater than resistance of parallel combination **(1)** P will have a greater (share of the) pd **OR** R will have a lower (share of the) pd **(1)** Reading on voltmeter will increase **(1)**	**3**
	Total for question 15	**15**

Question Number	Answer	Mark
16(a)(i)	Greater refraction at the first face **(1)** Greater refraction at the second face **(1)** (accept new incident ray if parallel)	**2**
16(a)(ii)	Displacement/it increases with concentration **(1)** At increasing rate **OR** not linearly **(1)**	**2**
16(a)(iii)	Evidence that curved line has been drawn **(1)** Concentration 74 % - 76% (dependent mark) **(1)**	**2**
16(a)(iv)	Distance (between prism and screen) affects displacement/ Displacement would increase if the screen is moved away/ Displacement would decrease if screen moved nearer **(1)**	**1**
16(b)(i)	Polarised light is when the oscillations / vibrations (associated with the wave) are in one plane only **(1)** Plane includes direction of travel (of the wave). **(1)** **OR** Polarised light is when the oscillations / vibrations (associated with the wave) in one direction only, **(1)** (oscillations / vibrations are) perpendicular to the direction of travel (of the wave). **(1)**	**2**
***16(b)(ii)**	(QWC- Work must be clear and organised in a logical manner using technical wording where appropriate.) **Max 4** • Mention of polarising filter/Polaroid/polariser **(1)** • Rotation (of filter) until minimum/ maximum intensity (**not** rotation of solution) **(1)** • (Rotation) done with and without the sugar solution **(1)** • identifies correct difference in angles **(1)** • use of protractor/polarimeter **(1)**	**4**
	Total for question 16	**13**

Question Number	Answer	Mark
***17(a)**	(QWC- Work must be clear and organised in a logical manner using technical wording where appropriate.) **Max 4** • Mention of photons **OR** photoelectric (NOT photoelectrons) **(1)** • Idea of one to one relationship from photon to electron **(1)** • Intensity of light relates to number of photons/sec **(1)** • wavelength/frequency is constant **(1)** • photon energy depends on frequency /reference to $E=hf$ **(1)** • Reference to $hf = \Phi + \frac{1}{2}mv^2_{max}$ **and** Φ constant **(1)**	**4**
17(b)(i)	*Use of* $E=hf$ **(1)** $E = 3.90 \times 10^{-19}$ (J) **Or** calculate the minimum frequency for all elements **(1)** Caesium and potassium [independent mark] **(1)**	**3**
17(b)(ii)	**Max 3** Refers to equation *E or* $1/2mv^2 = hf - \Phi$ **(1)** [Do not accept $hf = \Phi + 1/2mv^2$, equation must be correctly rearranged] *Gradient* **(1)** (All parallel) because gradient = h *Intercept* (-)Φ is intercept on the energy axis /y axis **(1)** **OR** f_0 / threshold frequency/ minimum frequency required to release an electron for the metal is the intercept on the frequency axis **OR** Φ/h is the intercept on the frequency axis potassium will have the smallest Φ **OR** zinc has the greatest Φ **(1)**	**3**
17(b)(iii)	Zinc requires higher frequency /Zinc requires UV/UV dangerous (for students)/UV ionising/Can't get UV filters **(1)** (Do not allow converse argument about Caesium for this mark) Caesium works with visible light **(1)**	**2**
	Total for question 17	**12**

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