Version 1.0

**General Certificate of Education (A-level)**
**June 2013**

# Physics B: Physics in Context PHYB2

# (Specification 2455)

# Unit 2: Physics keeps us going

# Final

# *Mark Scheme*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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| Question | Part | Sub Part | Marking Guidance | | Mark | Comments |
|---|---|---|---|---|---|---|
| 1 | | | no yes<br>yes no<br>no no<br>yes no | 4 | B1<br>B1<br>B1<br>B1 | each row correct for the mark |
| 2 | | | 390 or $3.9 \times 10^2$<br>W or $J\,s^{-1}$ or J/s | 2 | B1<br>B1 | allow kW values and correct base unit |
| 3 | (a) | | substitution or rearrangement of equation of motion<br>1.5(3 s) | 2 | C1<br>A1 | allow method using two equations of motion<br><br>allow methods using double the time to maximum height or total time |
| 3 | (b) | | any appropriate equation of motion used<br>2.8(7 m) ecf from (a) | 2 | C1<br>A1 | |
| 4 | (a) | | recognition that 39 (J) is input and 1.2 (J) is output<br>recognition that 1.2(3) ≈ 0.35 x 0.9 x 0.1 x 39 (J) | 2 | B1<br>B1 | 0.9 x 0.1 x 39 (J) = 3.51(J)<br>0.35 x 3.51(J) = 1.2(3 J)<br>gains two marks |
| 4 | (b) | | a minimum of two arrows<br>**two of** 20-30 squares (≈26 J),1-3 squares (≈1 J),10-12 squares(≈ 11 J) by eye<br>thermal/internal energy/heat (loss) labelled a minimum of once | 3 | C1<br><br>A1<br><br>B1 | condone arrows with values of losses for second marking point<br><br>penalise contradictions |

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| 5 | (a) | | potential divider formula used or current found to be 0.25 A<br>2.0 V | 2 | C1<br>A1 | allow 1 s.f.<br><br>1.0 V (with working) gains 1 mark |
| 5 | (b) | | main current =1.2 V/4Ω = 0.3 (A)<br>$R_{total}$ = 1.8 V/0.3 A = 6 Ω or $I_8$ = 0.225 (A)<br>$R_V$ = 24 Ω | 3 | C1<br>C1<br>A1 | |
| 6 | (a) | | $k = \frac{45}{30^2} \left(= \frac{45}{900} = 0.05\right)$ or $\frac{d}{45} = \frac{15^2}{30^2} \left(= \frac{1}{4}\right)$<br>$d$ = 11.25 (m) | 2 | C1<br>A1 | |
| 6 | (b) | | rearrangement or substitution into $v^2 = u^2 + 2as$ or $s = \frac{v+u}{2}t$<br>$a$ = (–) 10 or $t$ = 3.0<br>use of $F = ma$ or $Ft = mv - mu$<br>(–)7000 (N) | 4 | C1<br>A1<br>C1<br>A1 | allow use of more than one equation of motion provided it gives a deceleration or time |
| 6 | (c) | | mention of $E_K = \frac{1}{2}mv^2$<br>all used to heat brakes/surroundings<br>since both ke and $d$ are proportional to $v^2$<br>$d$ must be proportional to heat generated or to the kinetic energy | 3 max | B1<br>B1<br>B1<br>B1 | allow a mark for kinetic energy to 'heat'<br><br>$E=mdl2k$ gains two marks |
| 7 | (a) | (i) | two arrow acting downwards along each of the two ropes | 1 | B1 | do not allow arrows parallel to the ropes |
| 7 | (a) | (ii) | vertical component of tension = 390 or total downward force = 780 or sin65° seen<br>$T$sin65° = 390 or 2$T$sin65° = 780<br>$T$ = 430 (N) | 3 | C1<br><br>C1<br>A1 | allow cos25° |

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| 7 | (b) | (i) | (when object wholly or partially immersed in fluid) upthrust = weight of fluid displaced | 1 | B1 | |
| 7 | (b) | (ii) | $mg = \rho Vg$ or mass calculated<br>$2.94 \times 10^4$ (N) must show more than $3 \times 10^4$ | 2 | B1<br>B1 | allow a mark for calculating mass of cold air = 3000 kg |
| 7 | (b) | (iii) | recognition that net upward force($= 7.8 \times 10^2$) = upthrust – ($w_{balloon} + w_{hot\ air}$) or = $w_{cold\ air} - (w_{balloon} + w_{hot\ air})$<br>$w_{hot\ air} = 2.25 \times 10^4$ or difference between weight of hot and cold air = $7.5 \times 10^3$<br>$w_{balloon} = 6.1 \times 10^3$ (N) or $6.7 \times 10^3$ (N) using $3 \times 10^4$ | 3 | B1<br>B1<br>B1 | 6860/8000 gains two marks (780 ignored)<br>attempt to equate upward and downward forces gains mark |
| 8 | (a) | (i) | axis marked with **M** at 900-1100 nm | 1 | B1 | allow in line with axis on graph |
| 8 | (a) | (ii) | attempted use of or rearrangement of $\lambda_{max} T = 0.0029$<br>500 and 10,000 (irrespective of power of ten)<br>both values in nm | 3 | C1<br>A1<br>B1 | |
| 8 | (a) | (iii) | Sun's curve always above and peak at around 500 nm (by eye)(ecf) | 1 | B1 | |
| 8 | (b) | (i) | range of wavelengths which are transmitted/not absorbed by $CO_2$ owtte | 1 | B1 | |
| 8 | (b) | (ii) | at 10 000 nm $CO_2$ absorbs 100%/peak radiation emitted by Earth is all absorbed | 1 | B1 | allow 'most' for 100% |

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| 8 | (c) | | The marking scheme for this question includes an overall assessment for the quality of written communication (QWC). There are no discrete marks for the assessment of QWC but the candidate's QWC in this answer will be one of the criteria used to assign a level and award the marks for this question.<br><br>**Descriptor** – an answer will be expected to meet most of the criteria in the level descriptor.<br><br>**Level 3 – good**<br>-claims supported by an appropriate range of evidence<br>-good use of information or ideas about physics, going beyond those given in the question<br>-argument well-structured with minimal repetition or irrelevant points<br>-accurate and clear expression of ideas with only minor errors of grammar, punctuation and spelling<br><br>**Level 2 – modest**<br>-claims partly supported by evidence,<br>-good use of information or ideas about physics given in the question but limited beyond this<br>the argument shows some attempt at structure<br>-the ideas are expressed with reasonable clarity but with a few errors of grammar, punctuation and spelling<br><br>**Level 1 – limited**<br>-valid points but not clearly linked to an argument structure<br>-limited use of information about physics<br>-unstructured<br>-errors in spelling, punctuation and grammar or lack of fluency | 6 | B1<br>X6 | Level 3 answers must<br>• refer to wavelengths emitted by Sun and Earth<br>• explain greenhouse effect<br>• refer to global warming<br><br>Level 2 answers must have a minimum of two of these areas<br><br>Level 1 a minimum of one of these areas |

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| | | | **Level 0**<br>-incorrect, inappropriate or no response<br><br>examples of the sort of information or ideas that might be used to support an argument:<br><br>• (surface of) Sun at high temperature (~ 6000 K)<br>• Peak wavelength (blue) visible light<br>• atmosphere transparent to blue/long wavelength uv<br>• Earth atmosphere absorbs short wavelength uv and long wavelength ir<br>• Earth at much lower temperature (~ 300 K)<br>• Re-radiates at longer (ir) wavelength<br>• Atmosphere opaque to this and reflects back to Earth<br>• Earth at higher temperature than expected with no gases<br><br>Greenhouse gases – enhance global warming etc. | | | |

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| 9 | (a) | (i) | calculated cross-sectional area = $1.54 \times 10^{-6}$ ($m^2$) *or correct substitution*<br>into resistivity equation *with incorrect powers of ten correct substitution*<br>into resistivity equation *with correct powers of ten*<br>0.73 (Ω) | 3 | C1<br><br>C1<br>A1 | $1.6 \times 10^{-3}$ (treating *r* as *A*) gains 2 |

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| 9 | (a) | (ii) | Sub into $I^2R$ irrespective of power of 10 [ecf from (a)(i)]<br>$2.96 \times 10^{-4}$ (W) | 2 | C1<br>A1 | |

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| 9 | (b) | | line with positive slope(linear or curve)<br>knee and vertical line shown in first 2/3 on temperature axis<br>resistivity falling to zero above 0 K | 3 | B1<br>B1<br>B1 | |

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| 9 | (c) | | (with no resistance there can be) no power loss | 1 | B1 | |
| 10 | (a) | | smooth curve with a maximum value shown<br>gradient fairly constant or slight increase for half time<br>falls gradually on second half of swing | 2 max | B1<br>B1<br>B1 | condone non- zero at start and finish<br>oscillations score zero |
| 10 | (b) | | impulse is product of force and time<br>prolonging the time (of contact) increases momentum/velocity | 2 | B1<br>B1 | clear reference to impulse being force time product needed for first mark |
| 10 | (c) | (i) | use of $F=mv/t = 0.045 \times 58/180 \times 10^{-6}$<br>or $a= 58/180 = 3.2 \times 10^{5}$(ignore power for first mark)<br>$1.45 \times 10^{4}$ (N) | 2 | C1<br><br>A1 | use of 35 can gain first mark |
| 10 | (c) | (ii) | $(-)1.45 \times 10^{4}$ (N) | 1 | B1 | numerically equal to c(i) |
| 10 | (c) | (iii) | club head has inertia<br>club head only slows slightly on impact<br>club head still has kinetic energy/collision not elastic<br>increase in internal energy/'heat'/temperature of ball/club head | 2 max | C1<br>A1 | do not credit reference to friction<br>treat references to sound neutrally |