A-LEVEL

Physics B

PHYB2 – Physics Keeps Us Going
Mark scheme

2455
June 2015

Version 1: Final Mark Scheme

Mark schemes are prepared by the Lead Assessment Writer 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 associates 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 associate understands and applies it in the same correct way. As preparation for standardisation each associate 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, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

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Question	Part	Sub Part	Marking Guidance	Mark Type	Mark	Comments
1	a		Scalar has magnitude and vector has magnitude and direction	B1	1	Condone "size" for magnitude
1	b		Suitable e.g. acceleration / displacement / momentum	B1	1	
2			Right-angled triangle, nose-to-tail with arrows Appropriate scale (fills half the space minimum) 52 ± 1 (degrees)	M1 A1 B1	3	1 mark for 52.3^{o} by calculation
3	a		Ions (first box) Ions and (free) electrons (second box)	B1 B1	2	
3	b		(Free) electrons gain energy (from applied pd) / (free) electrons flow/move Electrons interact/collide with the ions of the lattice/metal Transferring their energy to ions / increasing the (kinetic/vibrational) energy of ions	B1 B1 B1	3	Allow "atoms" for ions
3	c		Substitution, ignoring powers of ten, into $\rho = \frac{R\,A}{L}$ Correct substitution 1.68×10^{-8} (Ω m) 2 sf answer with supporting calculation	C1 C1 A1 B1	4	
4	a		Correct use of horizontal speed = 9.2 (m s^{-1}) 7.4 (m)	C1 A1	2	Any method using area = zero
4	b		(Raising legs) increases her time in the air	B1	Max 2	

			(Raising legs) reduces air resistance / increases streamlining Distance travelled = horizontal velocity × time	B1 B1		
5	a		Geothermal	B1	1	
5	b		Solar/Wind/Waves/HEP/Tidal/Geothermal/Biomass Appropriate reason e.g. unreliability, limited availability, public opposition	B1 B1	2	
6	a	i	11 (m)	B1	1	
6	a	ii	Use of $F = k\Delta L$ or $W = mg$ 3400 (N)	C1 A1	2	Allow use of ΔL =12 m
6	b		Sets $mg = k\Delta L$ 1.9 (m)	C1 A1	2	
6	c		Correct use of $W = \frac{1}{2}k\Delta L^2$ or $\frac{1}{2}F\Delta L$ Correct use of $\Delta GPE = mg\Delta h$ States or uses $(mg\Delta h) - (\frac{1}{2} k\Delta L^2) = \frac{1}{2}mv^2$ 19 (m s^{-1}) cnao	C1 C1 C1 A1	4	ΔL = 5 m Δh = 25 m
6	d		Same kinetic energy when rope begins to stretch More work done per unit extension / stops in shorter distance Increases force on jumper (increasing the risk of injury)	B1 B1 B1	3	"Shorter time" gets no credit.

7	a	i	Use of $P = VI$ with pair of valid coordinates from graph 0.52 (W)	C1 A1	2	Allow 1sf if within 0.49 to 0.52
7	a	ii	Correct general shape Linear rise between 0.0 – 0.5 V and falls to zero at 0.71 V	M1 A1	2	
7	a	iii	Use of *efficiency* = $\frac{useful\ power\ out}{total\ power\ in}$ Use of $I = \frac{P}{A}$ Their (ai)/67.5 (m^2) (7.7×10^{-3} if correct)	C1 C1 A1	3	
7	b	i	0.7 J of work done (by cell) per 1 C of charge (when moved round circuit) OR (terminal) pd across (solar) cell with no load/current is 0.7 V	B1	1	Not "per unit charge"
7	b	ii	20 cells in series (to produce 14 V) Series arrangement has internal resistance of 15.6 Ω Cells in parallel (needed to reduce total internal resistance of array) 80 cells / 4 parallel sets of 20 cells in series	B1 B1 B1 B1	4	

7	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. **Descriptor** – an answer will be expected to meet most of the criteria in the level descriptor. **Level 3 – good** -claims supported by an appropriate range of evidence; -good use of information or ideas about physics, going beyond those given in the question; -argument is well structured with minimal repetition or irrelevant points; -accurate and clear expression of ideas with only minor errors of grammar, punctuation and spelling. **Level 2 – modest** -claims partly supported by evidence; -good use of information or ideas about physics given in the question but limited beyond this; -the argument shows some attempt at structure; -the ideas are expressed with reasonable clarity but with a few errors of grammar, punctuation and spelling. **Level 1 – limited** -valid points but not clearly linked to an argument structure; -limited use of information about physics; -unstructured; -errors in spelling, punctuation and grammar or lack of fluency. **Level 0** -incorrect, inappropriate or no response.	B6	6	Some points: **Use on communication satellite**: Continuous supply of energy from Sun No need for fuel (for power purposes) Large area of solar cells not needed (but possible) Low mass Can be unfolded (after launch) No environmental hazard Reliable/no moving parts **Continuous operation**: Arrays need to track sun (to maximise absorption) Shielding required as can be damaged by meteors or cosmic rays Need storage system (rechargeable batteries/capacitors) for back up (if in shadow) Limit use of energy-intensive operations **Use on space probe**: Light intensity/energy too low at large distance Intensity falls as inverse-square Area of array would be too large Solar cells will have degenerated too much over this time

8	a	i	85 - 23 / 0.14 = 440 seen	B1	1	
8	a	ii	Use of $A = \pi r^2$ or correctly makes k subject 207 W K^{-1} m^{-1}	C1 A1 B1	3	
8	a	iii	Lower (thermal) conductivity Smaller (cross-sectional) area / diameter Longer bar	B1 B1 B1	Max 2	Condone “thickness” for area
8	b	i	Read off R (57-59 Ω) from graph Use of $V_{out} = \frac{R_1}{R_1 + R_2} \times V_{in}$ 5.7 (V)	B1 B1 B1	3	Allow 5.6 to 5.8
8	b	ii	Towards R Resistance of thermistor decreases / Total resistance in circuit decreases Current increases Larger current through 100 Ω resistor (so large pd) OR Towards R Resistance of thermistor decreases pd splits in ratio of the resistors’ values 100 Ω has bigger proportion of ratio (therefore greater share of pd)	M0 A1 A1 A1	3	

9	a	i	Use of $KE = \frac{1}{2} m v^2$ 21.7 (J)	C1 A1	2	

9	a	ii	Use of $W = Fs$ 0.70 (m)	C1 A1	2	Allow 1 mark for use of suvat or F=ma

9	b		Use of $\Delta E_p = mg\Delta h$ Correct sub for h (1.7 sin 18^o) 77.3 (W) OR Use of $P=Fv$ Correct sub for F (mg sin 18^o) or v (1.7 sin 18^o) 77.3 (W)	C1 C1 A1	3	