Version 1.0

General Certificate of Education (A-level)
January 2012

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.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from: aqa.org.uk

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX.

NOTES

Letters are used to distinguish between different types of marks in the scheme.

M indicates OBLIGATORY METHOD MARK
This is usually awarded for the physical principles involved, or for a particular point in the argument or definition. It is followed by one or more accuracy marks which cannot be scored unless the M mark has already been scored.

C indicates COMPENSATION METHOD MARK
This is awarded for the correct method or physical principle. In this case the method can be seen or implied by a correct answer or other correct subsequent steps. In this way an answer might score full marks even if some working has been omitted.

A indicates ACCURACY MARK
These marks are awarded for correct calculation or further detail. They follow an M mark or a C mark.

B indicates INDEPENDENT MARK
This is a mark which is independent of M and C marks.

ecf is used to indicate that marks can be awarded if an error has been carried forward (ecf must be written on the script). This is also referred to as a 'transferred error' or 'consequential marking'.

Where a correct answer only (**cao**) is required, this means that the answer must be as in the marking scheme, including significant figures and units.

cnao is used to indicate that the answer must be numerically correct but the unit is only penalised if it is the first error or omission in the section (see below).

Marks should be awarded for **correct** alternative approaches to numerical question that are not covered by the marking scheme. A correct answer from working that contains a physics error (PE) should not be given credit. Examiners should contact the Team Leader or Principal Examiner for confirmation of the validity of the method, if in doubt.

GCE Physics, Specification B: Physics in Context, PHYB2, Physics Keeps Us Going

Question 1			
a	(quantity that has both) magnitude and direction	**B1**	**1**
b	any vector quantity eg velocity, force, acceleration	**B1**	**1**
		Total	**2**

Question 2			
	correct substitution into $F = k\Delta L$ (condone power 10 error) 0.064 (m)	**C1** **A1**	**2**
		Total	**2**

Question 3			
	statement that forces up = forces down/correctly resolved vertical component of either drag or tension 2600 *sin* 41 = *W* + 2200 *sin* 27 seen (or equivalent kN) 1705.8 = *W* + 998.8 (condone power 10 error) 707/710 (N)	**C1** **C1** **A1**	**3**
		Total	**3**

Question 4			
a	8.4 ($m\,s^{-1}$)	**B1**	**1**
b	correct substitution into Pythagoras' theorem **or** (d=) $\sqrt{(21^2 + 5^2)}$ **or** $\sqrt{466}$ or 21.6 seen correct sub into s= d/t **or** (s=) 21.6/2.5 **or** $\sqrt{466}/2.5$ seen 8.6(3) ($m\,s^{-1}$)	**C1** **C1** **A1**	**3**
		Total	**4**

Question 5			
	correct substitution into *U*-value formula 0.45/0.455 ($Wm^{-2}K^{-1}$)	**C1** **A1**	**2**
		Total	**2**

Question 6			
	attempted use of law of cooling/35 seen in workings finds time to halve= 60 s 35 (°C)	**C1** **C1** **A1**	**3**
		Total	**3**

Question 7			
a	correct substitution into $P = Fv$ 180 (W)	**C1** **A1**	**2**
b	higher power output/more air resistance refers to $P = Fv$ **and** states force (provided by cyclist) is greater while travelling at higher speed	**B1** **B1**	**2**
		Total	**4**

Question 8				
a		correct substitution into $P = V^2/R$ (condone power of 10 error) R = 2.62 (Ω) = 144/55 = 12^2/55 correct substitution into $\rho = RA/L$ (condone error on R and/or power of 10 errors) resistivity = 9.9(5) × 10^{-7} (range 9.9 to 9.95 × 10^{-7}) unit = Ω m	**C1** **C1** **C1** **A1** **B1**	**5**
b	i	joules per coulomb (of charge)/work done per unit charge (treat reference to force as neutral) where charge moved (whole way) round circuit	**M1** **A1**	**2**
b	ii	lost volts = 0.1 (V) or 0.1 seen as voltage r = 0.011 to 1.09 × 10^{-2} (Ω)	**C1** **A1**	**2**
c		brightness decreases increased current (in circuit/battery) increased lost volts leading to decreased pd across bulb or decreased terminal pd	**B1** **B1** **B1**	**3**
			Total	**12**

Question 9			
a	any attempted use of $mg\Delta h$ = power (or numerical equivalent) correct sub into $mg\Delta h$=9×10^7 or (m/t =) $9 \times 10^7/(9.81 \times 610)$ (condone power of 10) or correct use of efficiency (condone power of 10) (m/t =) $9 \times 10^7/(0.95 \times 9.81 \times 610)$ seen or equivalent (m/t =) $1.6 \times 10^4/15800\,(\text{kg s}^{-1})$	**C1** **C1** **C1** **A1**	**4**
b i	correct sub into $P = E/t$ (t=) $180 \div 0.09$ seen/ (t=) $180 \times 10^9 \div 9 \times 10^7$ seen/or 2000 (h)/7.2×10^6 (condone power of 10) (operating time per day=) $7.2 \times 10^6/365$ or 2000/365 5.48 or 5.5 (hours)	**C1** **C1** **A1**	**3**
b ii	limited amount of water (owtte)	**B1**	**1**
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 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		**5-6** **3-4**

	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 **Examples of the sort of information or ideas that might be used to support an argument:** **Load balancing** • matching production to consumption • energy continually produced by base load stations • variation in demand **At peak demand** • water from lower reservoir to upper reservoir • drives turbine – generator • gpe to electrical **At low demand** • water from lower reservoir to upper reservoir • pumps water • electrical to gpe **Benefits** **At low demand** • stores excess energy (otherwise stated) • uses cheaper electricity **At peak demand** • releases energy very quickly • saves using other more expensive peak stations • less CO_2 emissions **Problems** eg • limited suitable sites • damage to habitats/long transmission lines		**1-2**
		Total	**14**

Question 10				
a	i	$1.5 \times 10^4 / 1.46 \times 10^4$ (14550) (kg m s^{-1})	**B1**	**1**
a	ii	correct substitution into $t = (mv - mu)/F$ **or** (t =) $14550 \div 6.1 \times 10^3$ seen (condone power of 10 error) [ecf from part ai]	**C1**	**4**
		t = 2.39 s [ecf from part ai]	**C1**	
		correct substitution into $s = (u + v)t/2$ **or** (s =) $15 \times 2.39 \div 2$ seen (condone incorrect value for a calculated t in substitution)	**C1**	
		s = 17.9 to 18 m [ecf from part ai]	**A1**	
b		(braking distance) increases/'longer' to stop	**M0**	**max 3**
		greater mass	**A1**	
		more momentum/more time with rate of change of momentum equation	**A1**	
		same velocity change over longer time means greater distance /appropriate equation of motion with **s** as subject **and** longer time	**A1**	
		when using s = vt must identify v as average		
		or (braking distance) increases/'longer' to stop	**M0**	
		greater mass	**A1**	
		more ke (to convert)/more work to be done	**A1**	
		more work done by (same) force means greater distance/appropriate equation with **s** as subject	**A1**	
		or (braking distance) increases/'longer' to stop	**M0**	
		greater mass	**A1**	
		smaller acceleration	**A1**	
		smaller acceleration for (same) change in velocity means greater distance/appropriate equation of motion with **s** as subject	**A1**	
			Total	**8**

Question 11				
a	i	correct substitution into $I = P/A$ **or** (P =) $2.6 \times 10^{14} \times 5.0 \times 10^{2}$ seen 1.3×10^{17} (W)	**C1** **A1**	**2**
a	ii	1.3×10^{17} (W) (ecf)	**B1**	**1**
a	iii	correct substitution into $I = \frac{P}{4\pi r^2}$ or allow $4\pi r^2 = 2.6 \times 10^{14}$ **or** ($4\pi r^2$ =) $1.3 \times 10^{17} \div 250$ **or** 5.2×10^{14} (m^2) seen (ecf condone power of 10 error) (radius =) $6.4(3) \times 10^{6}$ (m) (ecf from part aii)	**C1** **A1**	**2**
a	iv	255 to 265 (K) **or** 13 seen **or** read off value – 273 –13 (°C) condone –8 to –18 (°C)	**C1** **A1**	**2**
a	v	greenhouse (effect)	**B1**	**1**
b		human activity produces CO_2/methane/greenhouse gases/ enhanced greenhouse effect absorbs more (of long λ) infrared/re-radiates less infrared/traps infrared lack of balance between inflow and re-radiated (owtte)	**B1** **B1** **B1**	**3**
c	i	correct substitution into $\rho = m/V$ condone power of 10 2.8×10^{15} (m^3)	**C1** **A1**	**2**
c	ii	no effect/negligible change (floating) ice already displaced water/displaced sea water weight = weight (floating) ice when melts, melted water only occupies the same volume as submerged part of ice pack (owtte)	**B1** **B1** **B1**	**3**
			Total	**16**

	UMS conversion calculator www.aqa.org.uk/umsconversion		