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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Physics 1456

Specification B: Physics in Context

PHYB2 Physics Keeps Us Going

Mark Scheme

2010 examination - January series

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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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 candidates' 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.

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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)	total energy consumption = 95 ($\times 10^{17}$) J 6.5 × 100/95 6.8/6.84 % [cao]	**C1** **C1** **A1**	**3**
		Total	**3**

Question 2			
	B	**B1**	**1**
		Total	**1**

Question 3			
(a)	$\sqrt{(1.3^2 + 1.0^2)}$ 1.6/1.64 ($m\,s^{-1}$)	**C1** **A1**	**2**
(b)	angle = $\tan^{-1}$ (1.0/1.3) N38°E/N37.6°E	**C1** **A1**	**2**
		Total	**4**

Question 4			
	$A = 4.9 \times 10^{-7} \times 0.95 \div 2$ area = 2.30×10^{-7} radius = $\sqrt{((A/\pi))} = 2.7 \times 10^{-1}$ (mm) diameter = 0.54 (mm)	**C1** **C1** **C1** **A1**	**4**
		Total	**4**

Question 5			
	max 2 from initial cost (estimated) life time cost per hour to run/amount of power to light	 **B1** **B1** **B1**	**2**
		Total	**2**

Question 6			
(a)	a force/1300 (condone power of ten error)	**C1**	
	6200 ÷ 1300	**C1**	**3**
	4.77 ($m\,s^{-2}$)	**A1**	
(b)	use of suitable kinematic equation	**C1**	
	eg distance = $27^2/(2 \times 4.8)$ correct sub	**C1**	**3**
	76/76.4 m/72.9 from a = 5/75.9 from a = 4.8	**A1**	
		Total	**6**

Question 7				
(a)	(i)	area = $2 \times 32 \times 10^6/1.3 \times (16)^3$ condone power of 10 error	**C1**	
		(area = 3610 m^2)	**C1**	**3**
		length = 62/61.9 m	**A1**	
(a)	(ii)	9.5 – 9.7 (MW) 9.4 – 9.8 (MW)	**A1**	**1**
(a)	(iii)	30(%) cao ecf from (a) (ii)	**A1**	**1**
(b)	(i)	energy in wind insufficient to turn mechanism	**B1**	**1**
(b)	(ii)	turbine must be feathered/stopped to prevent damage	**B1**	**1**
(b)	(iii)	funnel effect as slow moving air is 'squeezed' as it flows uphill/air density increases	**B1**	
		so air has to have higher speed	**B1**	**3**
		in order to have the same volume moving in smaller region in same time	**B1**	
			Total	**10**

Question 8			
(a) (i)	pd across resistor = 12 – 4.5 = 7.5 V	**C1**	**1**
(a) (ii)	I = (answer to (a) (i))/67 (allow 12/7.5/4.5 for this mark) 0.110/0.112 (A)	**C1** **A1**	**2**
(b) (i)	*360 + 67 (= 427) seen* $V = 12 \times 360/(360 + 67)$ 10.1 V	**C1** **C1** **A1**	**3**
(b) (ii)	substitution $P = V^2/R$ allow 360Ω/67Ω; 10V, 10.1V, 1.9V, 2V $1.9^2/67$ 0.053 W or J s^{-1}	**C1** **C1** **C1** **A1**	**4**
(c)	$1/R = 1/570 + 1/360$ 220 [Ω] total R = 287 Ω 42/41.7 mA $4.2 \times 10^{-2}/4.17 \times 10^{-2}$	**C1** **C1** **C1** **A1**	**4**
(d)	extra charge carriers released as temperature rises increased thermal agitation of atoms resists flow of charge carriers 1st effect overwhelms 2nd	**B1** **B1** **A1**	**3**
		Total	**17**

Question 9			
(a) (i)	area under graph = energy stored	B1	2
	area = ½ base × height	B1	
	or quotes ½ $F\Delta l$ **and** identifies F as F_{max} and Δl as d_{max}	B1	
(a) (ii)	equates ½ $F\Delta l$ and ½ mv^2 clearly	M1	2
	$v^2 = F_{max}d_{max}/m$ shown	A1	
(b) (i)	√650*0.60/0.060	M1	2
	81(80.6) (m s^{-1})	A1	
(b) (ii)	**max 1 from**		1
	friction between arrow and bow during release	B1	
	bow moves during release so absorbs some energy in kinetic form flight feathers provide drag	B1	
	uneven stretch/distortion in bow during draw	B1	
(c) (i)	65cos (35°) = 53.2 (m s^{-1})	B1	1
(c) (ii)	0 = 53.2 – 9.8 × t seen *condone sign errors*	B1	3
	t = 5.4 s to top of motion	B1	
	in air for 10.8/10.9 s	B1	
	or 0 = 53t – ½ × 9.8 × t^2 seen *condone sign errors*	B1	
	53t = ½ × 9.8 × t^2 *sign working must be correct*	B1	
	in air for 10.8 s *must be from correct working*	B1	
(c) (iii)	s = 65 × cos (55°) × 10.8	C1	2
	400 (m) 2 sf/405 (m) sf/410 m from 11 s	A1	
		Total	**13**

Question 10			
(a)	18.5	A1	1
(b)	equates ½ mv^2 and mgh, cancellation of m seen	C1	3
	v = √(2 × 9.8 × 150)	C1	
	54 (m s^{-1})	A1	

(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 candidates QWC in this answer will be one of the criteria used to assign a level and award the marks for this question. **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 **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 answer: • straw and snow can be compressed whereas frozen ground cannot be • momentum transfer would be same in both cases • the compression means that the time would be longer • quotes F = dp/dt/states result • so stopping force on rider must be reduced		**5-6** **3-4** **1-2** **0**
		Total	**10**