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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

2009 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.

Quality of Written Communication

Skill Level	Marks
Excellent to good (i) the answer provides a well-structured and logical explanation, procedure or argument which • answers the question in a piece of extend prose • has only minor inadequacies of grammar, spelling and punctuation (ii) the answer contains in-depth and relevant key physics as identified in the detailed mark scheme which is • correctly explained or applied in the context of the question, and • supported by relevant evidence of physics theory and presented in a logical sequence	5 or 6
Modest to adequate (i) the answer provides some structure and some explanation, procedure or argument **but** • is incomplete or not logically organised • has some significant errors of grammar, spelling or punctuation (ii) the answer contains most of the essential and relevant physics **but** • some key points are omitted or • the evidence or theoretical basis is incomplete	3 or 4
Poor to limited (i) the answer lacks structure and coherence and • the explanations, procedures or arguments are very limited and • there are many significant errors or grammar, spelling and punctuation (ii) the answers contains only limited relevant physics and little evidence of understanding, explanation of physics principles	1 or 2
No answer/totally irrelevant or incorrect answers	0

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

Question 1			
	work done = 1500 × 0.35 (525 J) or power = work done/time taken ✓ 615-620 W ✓ 2 or 3 sf only	**C1** **A1**	**2**
		Total	**2**

Question 2			
(a)	$v^2 = u^2 + 2as$ ✓ or $mgh = ½ mv^2$ correct substitution and manipulation seen i.e. $v^2 = 196$, $v = √196.2$ (m s^{-1}) or √(2 × 9.81× 10) ✓	**B1** **B1**	**2**
(b) (i)	deceleration = 14/0.54 or sensible attempt to use $F = ma$ ✓ 1170 N (1200 N) ✓ (no sf penalty)	**C1** **A1**	**4**
(ii)	friction **between the diver and the water** ✓ up thrust **due to water** (displaced) ✓ reaction force **due to water being accelerated/moved by the diver** ✓ (1 mark only for two correct causes without any amplification as shown)	**B1** **B1**	
		Total	**6**

Question 3			
(a)	2800/cos 20 = 3000 (2980) N ✓	**B1**	**1**
(b)	42000 J ✓	**B1**	**1**
		Total	**2**

Question 4			
	correct boxes ticked gravitational potential energy ✓ potential energy **and** kinetic energy ✓ elastic potential energy (in 'rope') ✓ (condone gravitational PE in addition)	**B1** **B1** **B1**	**3**
		Total	**3**

Question 5			
	recognises relevance of inverse square law by quoting equation ✓ 1700(1728) J s^{-1} ✓	**C1** **A1**	**2**
		Total	**2**

Question 6			
	increased temperature releases electrons ✓ further detail e.g. current increases (for a given pd) as number of charge carriers increases ✓ resistance is lower when charge carrier density is higher effect of increased charge carriers has more effect than the effect of more collisions with the lattice	**M1** **A1**	**2**
		Total	**2**

Question 7			
	correct substitution of data in resistivity formula 1.1(1) × 10^{-6} ✓ Ω m ✓	**C1** **A1** **B1**	**3**
		Total	**3**

Question 8			
(a)	the sprinter takes time to react to the starting pistol ✓	**B1**	**1**
(b)	attempt using tangent ✓ acceleration about 0.74 (0.68 – 0.80) ✓ m s^{-2} ✓	**C1** **A1** **B1**	**3**
(c)	appreciation that area under the graph ✓ distance per square = 1 m ✓ or clear use of scale in correct approach total squares =10 – 10.8 ✓ distance correct 10.1 - 10.6 m ✓ (unit essential) or alternative method using triangle and trapezium	**C1** **C1** **C1** **A1**	**4**

(d)	use a velocity sensor **or** record time to reach set distances ✓ detail about frequency at which data is collected ✓ sensor placed so that athlete runs toward it plot distance time graph and measure gradient at different times	**M1** **A1**	**2**
		Total	**10**

Question 9				
(a)	(i)	vertical speed = 22 sin 30 = 11 m s^{-1} ✓	**C1**	**5**
	(ii)	use of $v = u + at$ or substitution ✓	**B1**	
		or any correct alternative using equations of motion working leading to 1.12 s ✓	**B1**	
		working showing that it is doubled for up and down ✓	**B1**	
	(iii)	41.9 – 43 m ✓	**B1**	
(b)	(i)	**max 3 from** tennis ball doesn't travel as far because: tennis ball has lower KE when hit ✓ tennis ball has a rougher surface so more friction/air resistance) ✓ (although)rate of energy loss to air (initially) is the same ✓ tennis ball loses KE quicker ✓	 **B1** **B1** **B1** **B1**	**5**
	(ii)	sketch showing significantly lower height and range ✓ acceptable flight path initially same (for short distance then always below cricket ball path° ✓	**M1** **A1**	
			Total	**10**

Question 10			
(a)	temperature difference = 19 K used ✓ (24–5) seen attempt to use energy loss = $UA\,\Delta t$ (if correct energy lost) = 0.45 × 600 ×19 ✓ rate of loss of energy = 5130 W (5100 W if rounded) ✓	**C1** **C1** **A1**	**3**
(b)	rate reduced to 2166 W (2200 W if rounded) or power loss reduced by 2964 W ✓ saving per day = 766p to 792p ✓	**B1** **B1**	**2**

(c)	**generic marking scheme for QWC applies** **examples of the physics points made in the response** level 3 answer discusses three points adequately level 2 answer discusses two points adequately level 1 answer discusses one point adequately **efficient use: need to discuss at least 1 for level 3** • exclude draughts – energy has to be used to heat the cool air brought into the factory • lower inside temperature by a degree or two – this reduces the rate of loss of energy/reduces the energy used to achieve the required temperature • review the types of lighting used (change to energy efficient lamps) - same light output for less energy consumption • ensuring non essential use of electricity is reduced (switching off lights out of hours) – reduces energy demand • store off-peak electricity for heating during the day – energy used the same but uses energy generated at the power stations that would otherwise be wasted (e.g. night storage heaters) • use of energy efficient machinery -same task outcome for lower energy input • use of double glazing reduces heat loss so less energy needed to maintain factory temperature **efficient production: need to discuss at level 1 for level 3** • generate own supplies from renewable supplies with reason - mention of suitable supplies that use renewable energy such as solar panels or wind turbines - idea that carbon emissions reduction is achieved by reducing use of non-renewable fuels • use of heat pumps with some discussion of operation • use of electricity from 'ethical suppliers' who use renewable sources		**6**
		Total	**11**

Question 11			
(a) (i)	energy input needed = 2250 kW ✓ (450 × 5 seen or implied in calculation)	**B1**	**6**
	substitution in formula for *r* ((allow any power and condone incorrect power for k) ✓	**C1**	
	correct substitution including correct power 10^3 for k in kW ✓	**C1**	
	46(.4) m ✓	**A1**	
(ii)	area = 450000/210 = 2140 m^2 (i.e. forgets to use efficiency factor) ✓	**B1**	
	10 700 m^2 ✓ (ecf for input power needed from (i))	**B1**	
(b) (i)	emf from a cell is too low to power equipment ✓ or to increase the emf of the supply (allow higher voltage)	**B1**	**3**
(ii)	connecting cells in parallel lowers total resistance or show total resistance to be 3 Ω	**B1**	
	currents from each parallel section add up at the junction to the external circuit or output current increased	**B1**	
	if one cell is faulty the others still work/supply energy		
(c)	occasionally neither wind nor Sun's energy will be available ✓	**B1**	**2**
	back up using (one of)		
	connection to mains supply ✓ local generator using non-renewable fuel use(pumped) viable storage system use source that does not rely on wind or sun	**B1**	
		Total	**11**

Question 12			
(a)	use of power = *VI* ✓ 10.8 A ✓	**C1** **A1**	**2**
(b)	energy = *Pt* ✓ or use of *E* = *VIt* with incorrect power of 10 for *P* correct substitution or answer correct in s (1308 s) 21.8 minutes ✓	**C1** **C1** **A1**	**3**
(c)	resistance due to chemicals (components) inside the battery ✓ charge carriers collide (with ions) inside the battery current passes through the internal resistance ✓ **any one:** dissipates energy (that is wasted) ✓ reduces the voltage across the kettle/ results in lost volts/reduces terminal pd/ (allow battery operates at a lower voltage)	**B1** **B1** **B1**	**3**
		Total	**8**