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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 - June 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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Dr Michael Cresswell Director General

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			
(i)	C	**B1**	**1**
(ii)	B	**B1**	**1**
		Total	**2**

Question 2			
	attempt to use Newton's law of cooling (forgetting to subtract 10) **or** attempt in which 10 is subtracted from a temperature 70/130 = θ/70 so θ = 37.7 or 38°C 60/120 = θ/60 or arrives at 30°C (must see working) 40°C	**C1** **A1**	**2**
		Total	**2**

Question 3			
	vertical component of rope = 610 × cos (20) or 573 (N) 610 cos 20 seen in an equation (vertical component of resultant) = 590 – 573 or their F_v 16.8 or 17 (N) cao	**C1** **C1** **A1**	**3**
		Total	**3**

Question 4			
	selects power formula and attempts to use if or 12 given as answer 12I	**C1** **A1**	**2**
		Total	**2**

Question 5			
(i)	floating body displaces its own mass/weight of liquid (fluid)	**B1**	**1**
(ii)	no effect when the iceberg melts the water formed has a volume equal to the volume of the water in the space occupied by the submerged part of the iceberg (owtte)	**B1** **B1**	**2**
		Total	**3**

Question 6			
(i)	**zero** resistance at or below critical/transition temperature	**M1** **A1**	**2**
(ii)	one valid use mentioned or reason why important one valid use with reason why important or two significantly different valid uses two valid uses with reasons eg **uses** electromagnet/magnets for accelerators/scanners generators/transmission lines/electric cables/power transmission transformers computers (reason: increased speed and heating problems) amplifiers in radio astronomy (reason: low noise) **reasons** can produce very high magnetic field strengths can produce low-energy (power) loss conductors less energy/power wasted or lower energy loss	**B1** **B1** **B1**	**3**
		Total	**5**

Question 7			
(i)	correct substitution in formula for power available	**B1**	**2**
	correct formula and substitution including area and working leading to 416.7 kW or 417 kW	**B1**	
(ii)	62.5 or 63 kW	**B1**	**1**
		Total	**3**

Question 8				
(a)	(i)	65 × 9.8 × 35 seen and evaluated to 22295 or 2231 or 22300 J	**B1**	**8**
	(ii)	correct substitution of 65 kg and either 11000 J or 18 m s^{-1} in ke formula seen	**B1**	
		18.4 (18.397) (m s^{-1}) to at least 3 sf	**B1**	
	(iii)	distance = energy loss/force or work done/force or numerical equivalent	**C1**	
		64-64.3 using E_p = 20 kJ or 79 – 81 (m) using 22.3 kJ	**A1**	
	(iv)	friction	**B1**	
		air resistance	**B1**	
		further detail eg friction at ski-ice surface or caused by need to move air when passing through it	**B1**	
(b)	(i)	time = Δ*v*/*a* or numerical equivalent	**C1**	**4**
		6.4(3) – 6.6(6.57) (s)	**A1**	
	(ii)	use of appropriate kinematic equation	**C1**	
		(57.8 – 60.4) 58 m or 60 (m) to 2 sf	**A1**	
			Total	**12**

<table>
<tr><td>Question 9</td><td></td><td></td><td></td></tr>
<tr><td>(a)</td><td>
<table>
<tr><td></td><td>total resistance in circuit</td></tr>
<tr><td>X open, Y closed</td><td>R (given)</td></tr>
<tr><td>X closed, Y open</td><td>2/3 R</td></tr>
<tr><td>X open, Y open</td><td>2R</td></tr>
<tr><td>X closed, Y closed</td><td>R/2</td></tr>
</table>
</td><td>B1
B1
B1</td><td>3</td></tr>
<tr><td>(b)</td><td>energy dissipation is V^2/R
or approach using both $I = V/R$ and $P = VI$
highest resistance gives least energy
or X open, Y open or their highest tabulated resistance</td><td>B1
B1</td><td>2</td></tr>
<tr><td>(c)</td><td>electrons collide with ions
transferring energy to them/giving them or increasing their vibrational/kinetic energy</td><td>M1
A1</td><td>2</td></tr>
<tr><td>(d)</td><td>voltage across load lower or load voltage = $\frac{R}{(R+r)}V$
or load current reduced or load current = $\frac{V}{R+r}$
thermal energy output will decrease (in any stated circuit)
or identifies lowest resistance in table as being most affected
since $P=\frac{V^2}{R}$ or since power = I^2R</td><td>B1
M1
A1</td><td>3</td></tr>
<tr><td>(e) (i)</td><td>resistance = $\frac{\rho L}{\pi r^2}$ or substitution or $A = 1.16 \times 10^{-7}\,(m^2)$
1.93×10^{-4} (m) 0.193 mm</td><td>C1
A1</td><td rowspan="2">4</td></tr>
<tr><td>(ii)</td><td>two properties from
high resistance/resistivity (low electrical conductivity)
high melting point
low thermal capacity/specific heat capacity</td><td>B1
B1
B1</td></tr>
<tr><td></td><td></td><td>Total</td><td>14</td></tr>
</table>

Question 10			
(a)	5 wave per minute so T = 12 s	**C1**	**2**
	($4.0^2 \times 2.6 \times 12$ =) 500 (499) (kW)	**A1**	
(b)	graph with axes labelled with quantities (P and H) showing correct curvature heading toward origin in 1st square	**M1**	**2**
	detail correct: their power at 4 m and (4, 500 or 8, 2000; 2, 125) (ecf for their power)	**A1**	
(c)	**generic marking scheme for QWC applies** **examples of the physics points made in the response** renewable because energy from Sun generates winds winds generate waves **advantages** eg no pollution of water or air/greenhouse gases fuel cost/dependence on fossil fuels less visual pollution compared with… **disadvantages** eg lack of suitable sites/unreliable output; transmission problems/corrosive conditions		**max 6**
		Total	**10**

Question 11				
(a)	(i)	clear working:		**4**
		attempts to evaluate area under line (12 – 13 squares × 0.1 N s) or ½ × 106(105) × 24 × 10^{-3} seen	**B1**	
		1.260 – 1.272 (N s) 1.2 – 1.3 for square counting	**B1**	
	(ii)	area under graph/impulse = Δmv	**B1**	
		22.3 (22.8) (m s^{-1})	**B1**	
(b)		use of Pythagoras $\sqrt{22.3^2 + 6.1^2}$ or $\tan^{-1}$ (6.1/22.3)	**B1**	**3**
		or $\sqrt{20^2 + 6.1^2}$ or $\tan^{-1}$ (6.1/20)		
		22.8 – 23.8 (m s^{-1}) 20.9 or 21 (m s^{-1})	**B1**	
		14.9 – 15.5 (°) (15 – 16 (°)) 17/18 (°)	**B1**	
			Total	**7**

Question 12			
(a) (i)	thickness	**B1**	**5**
	(thermal) conductivity	**B1**	
(ii)	$\Delta\theta$ = 2500 ÷ 2.4 ÷ 24 or 43(.4)	**C1**	
	equilibrium temperature = 46 (adds 3 to their temperature difference)	**A1**	
	°C	**B1**	
(b)	max **two** from:		**max 2**
	draughts from outside/poor door seal/gaps in the walls	**B1**	
	air beneath base not at same temperature as other external faces	**B1**	
	air (wind) flow outside shed	**B1**	
	temperature variations on surfaces inside the shed due to convection currents/siting of the heater	**B1**	
		Total	**7**