

A-LEVEL

PHYSICS B: PHYSICS IN CONTEXT

PHYB2 – Physics Keeps Us Going

Mark scheme

2455

June 2014

Version: 1.0 Final

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.

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.

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COMPONENT NAME:

Unit 2 – Physics Keeps Us Going

COMPONENT NUMBER:

PHYB2

Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	a		Use of efficiency formula: an output energy ÷ an input energy seen $\frac{4.7 \times 10^{12}}{6.8 \times 10^{12}}$ or $\frac{6.8 - 4.7}{6.8}$ or $\frac{2.1}{6.8}$ or $\frac{5.1}{6.8}$ or $\frac{4.7}{5.1}$ or 0.75 or 0.92 Or 75% or 92% 0.69(1) penalise 1 sf / penalise unit	2	C1 Condone powers 10 error Input must be 6.8 or 5.1 A1 Allow 69 %
1	b		<u>Input</u> (often) from electricity produced by non-renewable resources Or <u>Input</u> (often) from electricity produced by named non-renewable resource Or Energy to <u>pump water</u> is from non-renewable resource	1	B1 Must be clear about Energy candidate is referring to. Could run out of <u>input</u> energylimiting case

1	c		<p><u>Short</u> start up time can meet surges in demand Or Produces a lot of energy <u>quickly</u></p>	1	B1	Condone minutes for start up time
2			<p>All accelerations are same</p> <p>(Because) only force acting (on the ball) is weight / moving(freely) under gravity / All have an acceleration of 9.81 m s^{-2}</p>	2	M1 A1	<p>Allow inference of same magnitude. Condone wrong directions or opposite signs for 1 mark</p> <p>All have an acc of 9.81 ms^{-2} scores two marks</p>
3	a		<p><u>Floating object</u> displaces (an amount of) fluid equal to its own weight Or For <u>a floating object</u>: upthrust = weight of <u>object</u></p>	1	B1	
3	b		<p>Decrease (not sinks) owtte</p> <p><u>more fluid to be displaced</u> to produce <u>larger upthrust</u> to float or weight of the tanker is(now) greater than the (initial) <u>upthrust</u> or <u>more fluid to be displaced to increase the weight</u> of the displaced water (to equal <u>the increased weight</u> of the tanker)</p>	2	B1 B1	Must refer to force(s) acting

4	a	<p>60/9.5 or 6.3 (litres) or 120/19</p> <p>Converts Wh to J or kWh to J $6.3 \times 10 \text{ (kW)} \times 3600$ or $6.3 \times 10 \times 30 \times 60$ (see 1.13 x 10⁸ 2marks) Or 10 kWh = 3.6×10^7 (J)</p> <p>2.27 x 10⁸ or 2.3 x 10⁸</p>	3	C1 C1 A1	Condone power 10 error
4	b	<p>Use of $P = \Delta W / \Delta t$ $2.3 \times 10^8 \div 1800$ or $63 \div 0.5$ or $63000 \div 0.5$ or <i>their ans (a) $\div 1800$ or their answer to 4(a) \div a recognisable time (30 (min) / 0.5 (h))</i></p> <p>1.26 x 10⁵ or 1.26 x 10⁵ or 1.3 x 10⁵ (W) ecf</p>	2	C1 A1	Condone power 10 error
4	c	<p>higher fuel consumption / more work done / More pollution / more CO₂ production/ More SOX (NOX) / more CO₂ production/ Increased acid rain / Increased greenhouse effect</p> <p>For the <u>same distance</u> of journeys / per km</p>	MAX 2	M1 1	More noise pollution (1 mark) Lower fuel economy(without explanation) (1 mark) Less efficient (without explanation) (1 mark)

5	a		identifies area of one square = 2 m / a recognizable formula / states that area under graph is distance 33 (squares) / area of trapezium or triangle and rectangle with working only/ Attempt to find correct area	2	B1 B1	sectioning off ticks
5	b		Straight line with positive gradient beginning at (3,0) ends at 14 s goes to (14,12)	3	M1 A1 A1	between 2.8 and 3.2
6	a	i	E / radiation	1	B1	General marker
6	a	ii	F / kinetic	1	B1	General marker
6	a	iii	C / rotational kinetic	1	B1	General marker
6	b	i	turbines are rotated to <u>face into wind</u> / Minimum distance between WTGs is maintained <u>in all directions</u> / Each WTG is the Minimum distance (5d) from <u>any other</u>	1	B1	

6	b	ii	<p>Use of $P=1/2 \pi r^2 \rho v^3$ (condone error in sub for r) or finds radius = $82/2=41$ Or finds area = $5281 \text{ (m}^2\text{)}$</p> <p>Rearranges to make v^3 subject condone incorrect sub for r ($r = 82$) or makes v subject of correct equation incorrect sub for r</p> <p>or $\sqrt[3]{\frac{1.6 \times 10^6}{\frac{1}{2} \pi \times 1.2 \times 41^2}}$ seen</p> <p>8.0 or 7.96 (m s^{-1}) cao</p>	3	C1 C1 A1	<p>Condone power of 10 error in sub for P</p> <p>Correct powers of 10</p> <p>$\frac{1.6 \times 10^6}{12674.4}$ (ans v =5)</p>
6	c		<p>More power available to a WTG / must increase spacing of WTGs</p> <p>no change (in power available per square metre of land)</p>	2	B1 B1	
7	(a)		<p>Rate of heat loss through 1 m^2 (of material) for 1 degree celsius temperature difference (across the material) Or States formula with terms defined</p>	1	B1	<p>Or energy transfer for heat</p> <p>Limiting case is $\text{W m}^{-2} \text{ K}^{-1}$ in words <u>including power</u></p>
7	(b)	(i)	<p>From graph heat transfer is zero at 18°C</p> <p>(Therefore) temperature difference (across wall) is zero / (therefore) temperatures are same (inside and out)</p>	2	B1 B1	<p>Reference to graph: extrapolation</p>

7	(b)	(ii)	(Area of brick \Rightarrow) $6.4 \times 2.5 - 7.5$ or $8.5 \text{ (m}^2\text{)}$ Or temp diff = $18-6$ or 12 (K) Use of U -value formula condone $\theta = 6$ <u>or</u> $A = 6.4 \times 2.5$ in substitution $180 / 183.6 / 184 \text{ (W)}$	3	C1 C1 A1	91.8 seen = 2 marks 345.6 seen = 2 marks
7	(b)	(iii)	(Finds heat loss through window = $640 - 184 = 456$ allow ecf 5.07 or $5.1 \text{ (W m}^{-2}\text{ K}^{-1}\text{)}$ ecf	2	C1 A1	Or subtracts b(i) from their incorrect read off of 680 or 620 (1 mark) =4.8 error 3.3 ecf, 6.1 ecf

8	(a)	Use of potential divider formula	condone R_1 , R_2 mix up	3	C1	condone powers of 10 error	
		Correct sub into formula	condone R_1 , R_2 mix up		C1	correct powers of 10	
		2.05 or 2.1 (V)			A1		
		Or (I =) 12 / 5550			C1	condone powers of 10 error	
		$(V = I \times R =) \frac{12}{5550} \times 950$ or $\frac{12}{5550} \times 4600$			C1	correct powers of 10	
		2.05 or 2.1 (V)			A1		
8	(b)	Resistance decreases		3	B1		
		Increased number of free electrons / <u>more</u> vibration of lattice / more free electrons / increased amplitude of vibration			B1		
		More vibration should increase resistance but more free electrons decreases resistance and this is dominant effect			B1	Allow charge carriers	
9	(a)	Use of $ke = \frac{1}{2} m v^2$ or sets $mgh = \frac{1}{2} m v^2$ and makes h subject		2	C1	PE equations of motion	
		14.7 / 15 (m)			A1		
9	(b)	(i)	Calculates the change in velocity ($a \times t$) seen		2	C1	
			$v = 15.7 / 16$ ($m s^{-1}$)			A1	

9	(b)	(ii)	Use of pythagoras' theorem: $\text{res vel}^2 = 15.7^2 + 17^2$ or $\text{res vel} = \sqrt{x^2 + 17^2}$ ecf	2	C1	
			23 or 23.1 or 23.3 (m s ⁻¹) ecf		A1	36.85, 37 ms ⁻¹ ecf

9	(c)		28° or 62° seen(inside right angled triangle)	2	C1	Calculated 25 in correct position on diagram Or 25 + 37
			13 or 12.7 (m s ⁻¹)		A1	

9	(d)		<p>Level 5-6</p> <p>slope: smaller change in vertical component of velocity smaller change in vertical component of momentum</p> <p>Technique: increases time for (same) momentum</p> <p>$F = \frac{\Delta mv}{\Delta t}$ is quoted (allow in words) and applied properly to either slope or technique or $F = m a$ and $a = \frac{\Delta v}{\Delta t}$ are quoted and applied properly to either slope or technique or $F = \frac{W}{s}$ is quoted and applied properly to either slope or technique</p> <p>level 3-4</p> <p>smaller change in velocity on slope (compared to horizontal) smaller change in momentum on slope (compared to horizontal) increases time reduces speed more gradually work done over bigger distance</p> <p>level 1-2</p> <p>decreases force (therefore less risk of injury) bends knees bending knees absorbs energy</p>	6	<p>B1 B1 B1 B1 B1</p>	<p>Faultless use of technical terms</p> <p>Must mention slope and technique</p> <p>Maximum of 4 for only slope or technique Good use of technical terms</p> <p>Poor use of technical terms</p>
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10	(a)		connects ammeter in series with cell and load resistor (any resistive load) Includes rheostat or other practicable means of obtaining range of data and voltmeter in parallel	2	B1 B1	Penalise extra incorrect meters / connecting wires/ resistors
10	(b)		Work done in moving unit charge or energy per coulomb or energy per unit charge or states formula and defines terms or joules per coulomb (Whole way) round circuit	2	B1 B1	Treat mention of force as neutral
10	(c)		2.8 (V)	1	B1	Attempts to find gradient gradient = (-) r no ecf on answer
			Read off of $V=0$ when $I = 2.2$ A or other point on line: (0.6,2) , (1.4,1)	3	C1	
			Use of $\epsilon = IR + Ir$ ecf for emf and approx read off 1.27 to 1.29 , 1.3 maximum (Ω) penalise minus sign on answer		C1 A1	
10	(d)	(i)	parallel Total emf unchanged / internal resistance of combination decreased / Two resistors in parallel therefore lower (by formula e.g.)	2	M1 A1	

10	(d)	(ii)	<p>Last longer</p> <p>More energy stored in combination</p> <p>Or</p> <p>Brighter / more efficient / more current / more power to bulb</p> <p>Combination has smaller <u>internal</u> resistance / less lost volts / larger terminal pd</p>	2	B1 B1	<p>One cell "runs down "or is faulty circuit still works (1 mark)</p> <p>1 mark statement 1 mark explanation</p>
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