A-LEVEL

PHYSICS B: PHYSICS IN CONTEXT

PHYB2 – Physics Keeps Us Going

Mark scheme

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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 $\frac{4.7\times10^{12}}{6.8\times10^{12}}$ 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 0r 75% or 92% 0.69(1) penalise 1 sf / penalise unit	2	C1 A1	Condone powers 10 error Input must be 6.8 or 5.1 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 <u>to 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> energy .....limiting case

1	c		Short start up time can meet surges in demand Or Produces a lot of energy quickly	1	B1	Condone minutes for start up time

2			All accelerations are same (Because) only force acting (on the ball) is weight / moving(freely) under gravity / All have an acceleration of 9.81 m s^{-2}	2	M1 A1	Allow inference of same magnitude. Condone wrong directions or opposite signs for 1 mark All have an acc of 9.81 ms^{-2} scores two marks

3	a		Floating object displaces (an amount of) fluid equal to its own weight Or For a floating object: upthrust = weight of object	1	B1	

3	b		Decrease (not sinks) owtte more fluid to be displaced to produce larger upthrust to float or weight of the tanker is(now) greater than the (initial) upthrust or more fluid to be displaced to increase the weight of the displaced water (to equal the increased weight of the tanker)	2	B1 B1	 Must refer to force(s) acting

4	a		$60/9.5$ or 6.3 (litres) or $120/19$ Converts Wh to J or kWh to J 6.3×10 (kW) $\times$ 3600 or 6.3 x 10 x 30 x 60 (see 1.13 x 10^8 2marks) Or 10 kWh =3.6×10^7 (J) 2.27 x 10^8 or 2.3 x 10^8	3	C1 C1 A1	 Condone power 10 error

4	b		Use of $P = \Delta W / \Delta t$ 2.3 x 10^8 ÷ 1800 or *63 ÷0.5 or 63000 ÷0.5 or their ans (a) ÷1800 or their answer to 4(a) ÷ a recognisable time (30 (min) / 0.5 (h))* 1.26 x 10^5 or 1.26 x 10^5 or 1.3 x 10^5 (W) ecf	2	C1 A1	Condone power 10 error

4	c		higher fuel consumption / more work done / More pollution / more CO_2 production/ More SOX (NOX) / more CO_2 production/ Increased acid rain / Increased greenhouse effect For the <u>same distance</u> of journeys / per km	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 face into wind / Minimum distance between WTGs is maintained in all directions / Each WTG is the Minimum distance (5d) from any other	1	B1	

6	b	ii	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 (m^2) Rearranges to make v^3 subject **condone incorrect** sub for r (r = 82) **or** makes v subject of correct equation incorrect sub for r or $\sqrt[3]{\frac{1.6\ x\ 10^6}{\frac{1}{2}\pi \times 1.2 \times 41^2}}$ seen 8.0 or 7.96 ($m\ s^{-1}$) cao	3	C1 C1 A1	Condone power of 10 error in sub for *P* Correct powers of 10 $\frac{1.6\ x\ 10\ 6}{12674.4}$ (ans v =5)

6	c		More power available to a WTG / must increase spacing of WTGs no change (in power available per square metre of land)	2	B1 B1	

7	(a)		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	1	B1	Or energy transfer for heat Limiting case is $W\ m^{-2}\ K^{-1}$ in words <u>including power</u>

7	(b)	(i)	From graph heat transfer is zero at 18°C (Therefore) **temperature difference** (across wall) **is zero** / (therefore) temperatures are same (inside and out)	2	B1 B1	Reference to graph: extrapolation

7	(b)	(ii)	(Area of brick =) 6.4 x 2.5 – 7.5 or 8.5 (m^2) Or temp diff = 18-6 or 12 (K) Use of *U*-value formula condone θ = 6 <u>or</u> A = 6.4 × 2.5 in substitution 180 / 183.6 / 184 (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 (W m^{-2} K^{-1}) 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 Correct sub into formula condone R_1 , R_2 mix up 2.05 or 2.1 (V) **Or** *(I =) 12 /* 5550 $(V = I \times R =) \frac{12}{5550} \times 950$ or $\frac{12}{5550} \times 4600$ 2.05 or 2.1 (V)	3	C1 C1 A1 C1 C1 A1	condone powers of 10 error correct powers of 10 condone powers of 10 error correct powers of 10

8	(b)		Resistance decreases Increased number of free electrons / <u>more</u> vibration of lattice / more free electrons / increased amplitude of vibration More vibration should increase resistance but more free electrons decreases resistance and this is dominant effect	3	B1 B1 B1	 Allow charge carriers

9	(a)		Use of $ke = ½ m v^2$ ***or*** *sets* $mgh = ½ m v^2$ ***and*** *makes h subject* 14.7 / 15 (m)	2	C1 A1	PE equations of motion

9	(b)	(i)	*Calculates the change in velocity* $(a \times t)$ *seen* v = 15.7 / 16 (m s^{-1})	2	C1 A1	

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

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

9	(d)		Level 5-6 slope: smaller change in vertical component of velocity smaller change in vertical component of momentum Technique: increases time for (same) momentum $F = \frac{\Delta mv}{\Delta t}$ 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 level 3-4 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 level 1-2 decreases force (therefore less risk of injury) bends knees bending knees absorbs energy	6	B1 B1 B1 B1 B1 B1 B1	Faultless use of technical terms Must mention slope and technique Maximum of 4 for only slope or technique Good use of technical terms Poor use of technical terms

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	
			Read off of V= 0 when I = 2.2 A or other point on line: (0.6,2) , (1.4,1) Use of ε = IR + Ir ecf for emf and approx read off 1.27 to 1.29 , 1.3 maximum (Ω) penalise minus sign on answer	3	C1 C1 A1	Attempts to find gradient gradient = (-) r no ecf on answer

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