



**General Certificate of Education (A-level)
January 2013**

Physics B: Physics in Context PHYB2

(Specification 2455)

Unit 2: Physics keeps us going

Final

Mark Scheme

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Question	Part	Sub Part	Marking Guidance	Mark	Comments
1			scale <1cm to 1 m s ⁻¹ stated or obvious from calculation (allow x 3, 7 etc. here) correct resultant direction by eye (needs arrow if not clear from parallelogram or triangle) 2.6±0.2 (m s ⁻¹)	3	B1 allow 2 max for correct calculation B1 B1 allow 1 max for correct method of calculation but with error(s)
2	a		$mgh = 160 \times 9.8 \times 2.4 = 3.8 \text{ kJ}$ $\eta = 84\% / 0.84$	2	C1 A1
2	b		weightlifter does work in raising his own body weight internal energy (allow heat) generated in muscles	1	B1 do not allow frictional effects
3			use of $4\pi r^2 / 2.83 \times 10^{23} \text{ (m}^2\text{)}$ seen an area multiplied by 1400 (W m ⁻²) (=3.96 x 10 ²⁶) any power value multiplied by 24 x 3600 (=86400) 3.4(2) x 10 ³¹ (J)	4	C1 C1 C1 A1
4	a		use of $E = ItV$ (or equivalent) or substitution into equation irrespective of powers of 10 emf = 4.0V 1.22x 10 ⁴ J	3	C1 C1 A1 allow 2 for 6120 (J)
4	b		Internal resistance = 1.2 (Ω) Current calculated (0.19 A) or potential divider formula used 3.7(7) V	3	C1 C1 A1 allow 2 for 0.22(6) V

5	a		Mention of(whole or partial) immersion (or floating) of body in fluid/liquid/water upthrust = weight of fluid/liquid/water displaced.	2	B1 B1	do not allow upthrust = weight of body for second mark
5	b		volume of whole melted iceberg equals (and replaces) the submerged portion . melted ice cap means water from land added to oceans so levels rise. credit comment on iceberg being freshwater slightly elevating the level of salt water.	2 max	B1 B1	
6	a	i	Statement or use of $s = \frac{1}{2}gt^2$ 0.247 s	2	C1 A1	
6	a	ii	9.0 m/answer to (a)(i) 36.4 m s^{-1}	2	C1 A1	
6	a	iii	reference to same time (to travel 2 nd 9.0 metres) / constant horizontal speed will not fall 2.4 m in 0.247 s / only fall total of 1.22 m / further distance of 0.9 m etc	2	B1 B1	allow 1 for horizontal velocity too great do not credit 'falls 0.3 after crossing net'
6	b		Hit it with a downward component /at downward angle (from higher) or put (top) spin on ball/hit ball less hard with upward component (lob it)	1	B1	do not credit 'hit with greater force' unless downward angle mentioned
6	c	i	calculation of (change in) momentum (8.37 Ns) momentum divided by time irrespective of power of 10 120 N (119.6)	3	C1 C1 A1	allow calculation of a and $F=ma$ approach

6	c	ii	kinetic energy \rightarrow elastic potential energy of ball + (ball does work on gas inside so) internal energy increases (treat sound as neutral) + net work done on ball itself as material goes through compress/stretch cycle so internal energy of ball rises	2 max	B1 B1	allow 1 for kinetic energy \rightarrow heat condone gpe added to kinetic energy
7	a	i	arrow gains more energy/aiming is more reliable/arrow travels faster or further	1	B1	
7	b		Attempt to calculate area under curve Area of 1 large square = 5 J Value between 75 and 85 J	3	M1 C1 A1	37.5 scores zero
7	c		Equating energy to $\frac{1}{2}mv^2$ $v^2 = 3.3 \times 10^3$ $v = 57.6 \text{ m s}^{-1}$	3	C1 C1 A1	
7	d		opposes motion of arrow / arrow has to do work on air range reduced / arrow slows down/ ke of arrow reduced falls less (in same time)	2max	B1 B1	

8	a	<p>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 candidate's QWC in this answer will be one of the criteria used to assign a level and award the marks for this question.</p> <p>Descriptor – an answer will be expected to meet most of the criteria in the level descriptor.</p> <p>Level 3 – good</p> <ul style="list-style-type: none"> -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 <p>Level 2 – modest</p> <ul style="list-style-type: none"> -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 <p>Level 1 – limited</p> <ul style="list-style-type: none"> -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 <p>Level 0</p> <ul style="list-style-type: none"> -incorrect, inappropriate or no response <p>examples of the sort of information or ideas that might be used to support an argument:</p> <ul style="list-style-type: none"> • Uneven heating of Earth by Sun → temp differences • Pressure differences • Air moves from high to low pressure 	6	B1 X6	<p>level 3 must include</p> <ul style="list-style-type: none"> • mechanism causing winds • principal energy change • design of wind turbine/physics of siting <p>level 2 must address at least two of these areas a</p> <p>level 1 at least one of these areas</p>
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			<ul style="list-style-type: none"> • Directions influenced by rotation of Earth etc • Wind kinetic energy → turbine rotational ke → electricity • Wind turbine/generators use rotating blades • Relative motion between coil and magnetic field • Long blades and high winds produce greater power • Down time to avoid damage to turbines caused by too high speeds restricts use • Sites need to have continual wind • Off-shore and high sites avoid shadows, drag and turbulence • Environmental/aesthetic comments 			
8	b		substitution into $P = \frac{1}{2} \pi r^2 \rho v^3$ irrespective of powers of 10 0.36 (MW) 2 s.f. only	3	C1 A1 B1	363 gains 1 360 gains 2
8	c		(All ke transferred to turbine assumed) air leaving the blades still retains some ke therefore not possible Wind strikes turbine tangentially / turbine not facing into wind Air flow turbulent friction in turbine (bearings)	2max	B1 B1	do not condone wind speed varies or less than 9.5 m s^{-1} or effects of friction
9	a		Natural – hot surface (conducts heat to surroundings which) causes expansion and upward flow of air – owtte Forced –air blows across hot surface – (removing warmer boundary layer/air)	2	B1 B1	
9	b	i	52 → 26 one half life 26 → 13 second half life therefore 16.00 hours	2	M1 A1	

9	b	ii	line curves in the correct direction from right starting point (exponential decay) minimum of two of the times of 08.00, 12.00, 16.00, 20.00 with temps of 74, 48, 35, 28(.5) even with straight line	2	B1 B1	allow 1 for straight line if scale has been made logarithmic for values other than those given
9	c		recognition that $P \propto U$ attempt to use $\frac{U_1 - U_2}{U_1}$ 60% (decrease)	3	C1 C1 A1	40% gains 1 mark
10	a		1 joule per coulomb (or equivalent)	1	B1	allow watt per amp
10	b	i	Use of potential divider formula 4.95 (V)	2	C1 A1	allow 1 for 4.05 (V) or current of 2.25 (mA)
10	b	ii	reduced current	1	B1	
10	b	iii	use of parallel resistor formula leading to 1.72 (k Ω) pd = 4.4 (V)	3	C1 C1 A1	
10	b	iv	potential divider can provides sensitive control of current (from 0-1.1 mA) variable resistor can provide larger current but cannot get near 0 A owtte	2	B1 B1	allow pot div can provide zero current and variable resistor gives larger current