Question Number	Answer	Acceptable answers	Mark
1(a)	Any **one** of the following points • unreliability (1) e.g. wind does not always blow / wind speed may be too high/too low • pollution (1) e.g. noise from wind turbines / wind turbines spoil the view	Ignore general references to weather ignore economic arguments the wind is unreliable only works when it is windy wind turbines can only use a (small) range of wind speeds visual pollution	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	transposition (1) current = power ÷ voltage substitution (1) 322 000 000 ÷ 132 000 evaluation (1) 2440 (A)	Transposition and substitution may be in either order Transposition may be implied by correct figures I = P ÷ V Ignore powers of ten until final answer i.e. give 2 marks for 322 ÷ 132 2439 (A) 2439.39….(A) 2.44 kA give full marks for correct answer, no working give 2 marks for a power of 10 error, no working e.g. 2.44 (A)	**(3)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	• calculation to find additional power generated e.g. 539 – 322 = 217 (MW) (1) • 2.9 (MW) (1)	217 without working 2.893 (MW) give full marks for correct answer, no working	**(2)**

Question Number		Indicative content	Mark
QWC	***1(c)**	A discussion to include some of the following points Social factors / economic factors • people may not like it (NIMBY) / pressure groups • cost arguments Environmental factors • spoiled view / risk of birdstrike • space for extra infrastructure eg. access roads / substations Associated hazards • danger from higher voltage • dangers from construction work in mountainous area • danger to maintenance crew from working at greater height Energy efficiency arguments • higher voltage leads to lower current • lower current means reduced heat losses • higher voltage means / lower current / can transmit energy further • reduced heat loss means improved efficiency Logical use of data • taller pylons can be seen from further away • net reduction in number of pylons / need to remove old ones • stronger materials needed for pylons / cables • need for new transformers Appropriate calculations • 1000 - 600 = 400 fewer pylons (approx) • current reduced by a factor of 132/400 (0.33)	**(6)**

Level	0	no rewardable material
1	**1-2**	• a limited discussion of the plan to replace the power transmission lines (or upgrade the wind farm) including two or more points, advantageous (A) or disadvantageous (D), which may appear as a list e.g. (A+D) is more efficient; is expensive OR (A+A) uses fewer pylons; current is lower OR (D+D) would spoil the view; high voltage is dangerous • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3-4**	• a simple discussion of the plan to replace the power transmission lines including two or more statements, advantageous (A) or disadvantageous (D), at least one of which links ideas e.g. (A) higher voltage *leads to* lower current + (D) if old pylons are removed they will go to waste OR (A) using higher voltage *means* energy can be transmitted further + (A) wasting less energy saves money OR (D) new pylons spoil the view more *because* they are taller + (D) danger to maintenance crew from working at greater height • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed discussion of the plan to replace the power transmission line, including an advantage (A) **AND** a disadvantage (D) both containing linked ideas, at least one of which shows use of the data e.g. (A) Increasing the voltage to 400 kV *leads to* a reduction in the current (needed to transmit the same power) + (D) higher voltages will *mean* that they need new transformers OR (A) it will be more efficient *because* less energy is wasted + (D) *even though* there will be 400 fewer pylons they will be taller and can be seen from further away • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Question Number	Answer	Acceptable answers	Mark
2(ai)	Model A because Model A (can produce up to)7200kWh per year (at 13mph) / will produce 6000 kWh (with given wind speed). (1)	 Model B produces less than 6000kWh per year at 13mph /requires wind speed of more than 13mph to produce 6000kWh	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(aii)	Substitution (1) 0.14 x 6000 Evaluation (1) (£)840	Allow incorrect conversion of p to £ such as 0.014 x 6000 for 1 mark only 84 000 p correct answer with no working shown gains both marks	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(aiii)	Divide the installation cost by the annual saving (to find the time in years) (1)	£840 for annual saving	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(aiv)	A suggestion linking (energy saving lamps) would not transfer so much thermal energy (1) he may have to use additional heating / lights (which would cost money to run/ purchase) (1)	 not get hot / produce so much heat reverse argument such as insufficient heat for chicks to thrive (Ignore references to light output.)	**(2)**

Question Number		Indicative Content	Mark
QWC	***2(b)**	A discussion including some of the following points • Both HEP and Solar power are renewable • Both HEP and Solar power would save fossil fuels • HEP only possible in some locations • HEP requires reservoirs and damming of rivers • This can damage environment /takes a lot of land out of use • Energy from solar power installation is currently much less than energy from fossil fuel powered station • Solar power only suitable in certain locations • Solar power reliability dependent on constant sunshine • Neither of them cause atmospheric pollution	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description such as at least one relevant detail of each resource eg: Solar power doesn't give off atmospheric pollution. HEP generates more power than solar power. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple discussion such as one which gives comparisons between the two or at least an advantage and disadvantage of both. eg: HEP does not use fossil fuels but it can damage the environment where is it located. Solar power will never run out but it requires lots of light/land. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed comparison such as one which relates advantages and disadvantages of **both** HEP and solar power to a particular situation for possible large scale use e.g.: Solar power uses a renewable energy source but it currently does not produce as much energy as fossil fuel station where there is little sunlight. HEP can produce a lot more energy where there are hills and water but only possible in certain geographical locations. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Question number	Answer	Additional guidance	Mark
3(a)	An answer that combines the following points of understanding to provide a logical description: • measurement of time between(or at) two positions using suitable timing equipment (1) • measurement of suitable distance along the runway with metre rule (1) • measurement of vertical height to starting position (1) • repeats AND averages AND use of a correct equation (1)	allow stopwatch, light gates minimum is 0.5 m metal tape measure average speed = distance/time OR average speed = (speed at A − speed at B)/2	**(4)**

Question number	Answer	Additional guidance	Mark
3(b)(i)	Substitution of correct data from graph and mass conversion (1) $0.5 \times 0.65 \times (0.61)^2$ Answer (1) 0.12 (J)	maximum of 1 mark if mass in g used allow tolerance of ±0.2 for speed	**(2)**

Question number	Answer	Additional guidance	Mark
3(b)(ii)	• Tangent to the graph at h = 0.1 (1) • Answer in the region 3.5 to 3.6	either seen on graph or suitable pairs of values of Δv and Δh	**(2)**

Question number	Answer	Mark
3(b)(iii)	An answer that combines points of interpretation/evaluation to provide a logical description: • for each change in height, as the height increases the speed of the trolley increases • the greatest change in speed is between the change in height from 0.04 m to 0.9 m	(2)

Question number	Answer	Additional guidance	Mark
3(c)	An answer that combines the following points to provide a logical description of the plan/method/experiment: • identifies control variables (1) • uses at least 3 different surfaces (1) • calculates average speed for each surface and repeats (1)	constant height, constant slope, constant starting points and same length of surface	(3)