

| Question Number | Answer                           | Acceptable answers | Mark       |
|-----------------|----------------------------------|--------------------|------------|
| <b>1(a)</b>     | A transverse and electromagnetic |                    | <b>(1)</b> |

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|-----------------|---|--|------------|
| <b>1(b)</b>     | <p>Evaluation 171.5 (1)</p> <p>Substitution<br/>(34.3/171.5) x 100 (1)</p> <p>Evaluation<br/>20 (%) (1)</p> | <p>award full marks for correct answer with no working</p> <p>34.3 x 5</p> <p>[34.3 / (34.3 x 5)] x 100<br/>[34.3 / (34.3 x 5)]<br/>[34.3 / 171.5]</p> <p>Allow 0.2 or 1/5 for 3 marks</p> | <b>(3)</b> |

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|-----------------|--|--|------------|
| <b>1(c)</b>     | <p>rate of {energy/heat} (from the Sun){absorbed/taken in} (1)</p> <p>equals rate of {energy/heat} {radiated/emitted/given out}(1)</p> | <p>Allow 'energy in = energy out' for 1 mark</p> <p>'power in = power out' for 2 marks</p> | <b>(2)</b> |

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|-----------------|---|---|------------|
| <b>1(d)</b>     | <p>Any two suggestions from:</p> <p>reflection (from external connections/plastic cover)(1)</p> <p>absorption by {external connection/ plastic cover/back plate} (1)</p> <p>transmission (through back plate) (1)</p> | <p>Not all energy absorbed by silicon layer/absorbed by wrong parts</p> | <b>(2)</b> |

Total for Question 1 = 8 marks

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|-----------------|---|---|------------|
| <b>2(a)</b>     | <p>Any <b>one</b> of the following points</p> <ul style="list-style-type: none"> <li>unreliability (1)<br/>e.g. wind does not always blow / wind speed may be too high/too low</li> <li>pollution (1)<br/>e.g. noise from wind turbines / wind turbines spoil the view</li> </ul> | <p>Ignore general references to weather<br/>ignore economic arguments</p> <p>the wind is unreliable<br/>only works when it is windy<br/>wind turbines can only use a (small) range of wind speeds</p> <p>visual pollution</p> | <b>(1)</b> |

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| <b>2(b)(i)</b>  | <p>transposition (1)<br/>current = power ÷ voltage</p> <p>substitution (1)<br/>322 000 000 ÷ 132 000</p> <p>evaluation (1)<br/>2440 (A)</p> | <p>Transposition and substitution may be in either order<br/>Transposition may be implied by correct figures</p> <p><math>I = P \div V</math></p> <p>Ignore powers of ten until final answer i.e. give 2 marks for <math>322 \div 132</math></p> <p>2439 (A)<br/>2439.39....(A)<br/>2.44 <u>k</u>A</p> <p>give full marks for correct answer, no working<br/>give 2 marks for a power of 10 error, no working e.g. 2.44 (A)</p> | <b>(3)</b> |

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| <b>2(b)(ii)</b> | <ul style="list-style-type: none"> <li>calculation to find additional power generated e.g.<br/><math>539 - 322 = 217</math> (MW) (1)</li> <li>2.9 (MW) (1)</li> </ul> | <p>217 without working</p> <p>2.893 (MW)</p> <p>give full marks for correct answer, no working</p> | <b>(2)</b> |

| Question Number | Indicative content   | Mark       |
|-----------------|--|------------|
| <b>QWC</b>      | <p data-bbox="261 138 342 175"><b>*2(c)</b></p> <p data-bbox="367 138 1127 175">A discussion to include some of the following points</p> <p data-bbox="367 212 846 249">Social factors / economic factors</p> <ul data-bbox="415 249 1187 318" style="list-style-type: none"> <li data-bbox="415 249 1187 286">• people may not like it (NIMBY) / pressure groups</li> <li data-bbox="415 286 691 318">• cost arguments</li> </ul> <p data-bbox="367 355 691 392">Environmental factors</p> <ul data-bbox="415 392 1349 461" style="list-style-type: none"> <li data-bbox="415 392 919 429">• spoiled view / risk of birdstrike</li> <li data-bbox="415 429 1349 461">• space for extra infrastructure eg. access roads / substations</li> </ul> <p data-bbox="367 498 651 535">Associated hazards</p> <ul data-bbox="415 535 1349 641" style="list-style-type: none"> <li data-bbox="415 535 867 572">• danger from higher voltage</li> <li data-bbox="415 572 1243 609">• dangers from construction work in mountainous area</li> <li data-bbox="415 609 1349 641">• danger to maintenance crew from working at greater height</li> </ul> <p data-bbox="367 678 789 715">Energy efficiency arguments</p> <ul data-bbox="415 715 1341 891" style="list-style-type: none"> <li data-bbox="415 715 1008 752">• higher voltage leads to lower current</li> <li data-bbox="415 752 1065 788">• lower current means reduced heat losses</li> <li data-bbox="415 788 1341 854">• higher voltage means / lower current / can transmit energy further</li> <li data-bbox="415 854 1122 891">• reduced heat loss means improved efficiency</li> </ul> <p data-bbox="367 927 643 964">Logical use of data</p> <ul data-bbox="415 964 1357 1103" style="list-style-type: none"> <li data-bbox="415 964 1105 1001">• taller pylons can be seen from further away</li> <li data-bbox="415 1001 1357 1038">• net reduction in number of pylons / need to remove old ones</li> <li data-bbox="415 1038 1130 1075">• stronger materials needed for pylons / cables</li> <li data-bbox="415 1075 854 1103">• need for new transformers</li> </ul> <p data-bbox="367 1140 724 1177">Appropriate calculations</p> <ul data-bbox="415 1177 1138 1246" style="list-style-type: none"> <li data-bbox="415 1177 1057 1214">• <math>1000 - 600 = 400</math> fewer pylons (approx)</li> <li data-bbox="415 1214 1138 1246">• current reduced by a factor of <math>132/400</math> (0.33)</li> </ul> | <b>(6)</b> |

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|--------------|--------------|--|
| <b>Level</b> | <b>0</b>     | no rewardable material   |
| <b>1</b>     | <b>1-</b>    | <ul style="list-style-type: none"> <li>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</li> <li>OR (A+A) uses fewer pylons; current is lower</li> <li>OR (D+D) would spoil the view; high voltage is dangerous</li> <li>the answer communicates ideas using simple language and uses limited scientific terminology</li> <li>spelling, punctuation and grammar are used with limited accuracy</li> </ul>  |
| <b>2</b>     | <b>3-</b>    | <ul style="list-style-type: none"> <li>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 <i>leads to</i> lower current + (D) if old pylons are removed they will go to waste</li> <li>OR (A) using higher voltage <i>means</i> energy can be transmitted further + (A) wasting less energy saves money</li> <li>OR (D) new pylons spoil the view more <i>because</i> they are taller + (D) danger to maintenance crew from working at greater height</li> <li>the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately</li> <li>spelling, punctuation and grammar are used with some accuracy</li> </ul>               |
| <b>3</b>     | <b>5 - 6</b> | <ul style="list-style-type: none"> <li>a detailed discussion of the plan to replace the power transmission line, including an advantage (A) <b>AND</b> a disadvantage (D) both containing linked ideas, at least one of which shows use of the data e.</li> <li>(A) increasing the voltage to 400 kV <i>leads to</i> a reduction in the current (needed to transmit the same power) + (D) higher voltages will <i>mean</i> that they need new transformers</li> <li>OR (A) it will be more efficient <i>because</i> less energy is wasted + (D) <i>even though</i> there will be 400 fewer pylons they will be taller and can be seen from further away</li> <li>the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately</li> <li>spelling, punctuation and grammar are used with few errors</li> </ul> |

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| <b>3(a)</b>     | B      |                    | <b>(1)</b> |

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|-----------------|---|---|------------|
| <b>3(b)(i)</b>  | <p>an explanation linking <b>three</b> of the following</p> <ul style="list-style-type: none"> <li>• (waves cause) float to move (up and down)(1)</li> <li>• (this causes) magnet to move (in and out of coil) (1)</li> <li>• (hence) magnetic field (of magnet) (1)</li> <li>• cuts across/links/ interacts wire in coil (1)</li> <li>• <u>inducing/generating</u> potential difference across ends of coil (1)</li> </ul> | <p>magnet moves (in the coil)</p> <p><b>Allow</b>{current/voltage/volts/am ps} <u>induced/generated</u> in coil</p> | <b>(3)</b> |

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| <b>3(b)(ii)</b> | <p>a description including <b>two</b> of the following</p> <ul style="list-style-type: none"> <li>• increase the number of turns on the coil (1)</li> <li>• use a more powerful magnet (1)</li> <li>• use full scale device (1)</li> </ul> | <p>more coils (of wire)<br/>ignore bigger coil</p> <p>stronger/more magnets<br/><b>Ignore</b> bigger magnet</p> <p><b>Allow</b> idea of more/bigger/ faster waves</p> | <b>(2)</b> |



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| <b>QWC</b>      | <b>*3(c)</b><br>A discussion linking some of the following<br><b>Advantages of tidal power</b> <ul style="list-style-type: none"> <li>• renewable energy source</li> <li>• reduction in greenhouse gases/atmospheric pollution ( compared to fossil fuel)</li> <li>• reduces reliance on fossil fuels</li> <li>• conserves stocks of fossil fuels</li> <li>• predictable source of energy</li> <li>• regular/reliable supply of energy</li> <li>• barrages at different areas would give energy supply at different times</li> </ul> <b>Disadvantages of tidal power</b> <ul style="list-style-type: none"> <li>• does not give continuous supply of energy</li> <li>• destruction of plant/animal/bird habitats</li> <li>• problems with passage of ships</li> <li>• affects migration of fish</li> <li>• high capital cost /very long payback time</li> <li>• pollution caused from producing /transporting building materials</li> <li>• visual pollution</li> </ul> This list is not exhaustive. Give credit for other plausible suggestions | <b>(6)</b>             |
| <b>Level</b>    | <b>0</b>   | No rewardable material |
| <b>1</b>        | <b>1-</b> <ul style="list-style-type: none"> <li>• there is limited discussion of the advantages or disadvantages of tidal power ie gives one advantage OR one disadvantage of tidal power.<br/>e.g. tidal power is not available 24 hours a day/ The barrage will save fuel for motorists going to the town on the other side ( of the estuary)</li> <li>• the answer communicates ideas using simple language and uses limited scientific terminology</li> <li>• spelling, punctuation and grammar are used with limited accuracy</li> </ul>   |                        |
| <b>2</b>        | <b>3-</b> <ul style="list-style-type: none"> <li>• there is some discussion of the advantages and disadvantages of tidal power<br/>ie gives one advantage AND one disadvantage of tidal power<br/>e.g. an advantage of tidal power is that it uses a renewable energy resource and a disadvantage is that they damage birds' habitats</li> <li>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately</li> <li>• spelling, punctuation and grammar are used with some accuracy</li> </ul>   |                        |
| <b>3</b>        | <b>5 - 6</b> <ul style="list-style-type: none"> <li>• there is detailed discussion of the advantages and disadvantages of tidal power ie gives one advantage AND one disadvantage of tidal power, one of which is detailed, AND a clear link to another method<br/>e.g. tidal power stations are a good idea because they use a renewable energy resource and will help to conserve fossil fuel stocks. However, it causes problems for migrating fish</li> <li>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br/>ling, punctuation and grammar are used with few errors</li> </ul>   |                        |

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| <b>4(ai)</b>    | Model A because<br><br>Model A (can produce up to )7200kWh per year (at 13mph) / will produce 6000 kWh (with given wind speed).<br>(1) | Model B produces less than 6000kWh per year at 13mph /requires wind speed of more than 13mph to produce 6000kWh | <b>(1)</b> |

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| <b>4(aii)</b>   | Substitution (1)<br>0.14 x 6000<br><br><br><br><br><br><br><br><br>Evaluation (1)<br>(£)840 | Allow incorrect conversion of p to £ such as 0.014 x 6000 for 1 mark only<br><br><br><br>84 000 p<br><br>correct answer with no working shown gains both marks | <b>(2)</b> |

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| <b>4(aiii)</b>  | Divide the installation cost by the annual saving (to find the time in years)<br>(1) | £840 for annual saving | <b>(1)</b> |

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| <b>4(aiv)</b>   | A suggestion linking<br><br>(energy saving lamps) would not transfer so much thermal energy<br>(1)<br><br>he may have to use additional heating / lights (which would cost money to run/ purchase) (1) | not get hot / produce so much heat<br><br><br>reverse argument such as insufficient heat for chicks to thrive<br><br><br>(Ignore references to light output.) | <b>(2)</b> |



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|-----------------|--------------|---|------------|
| <b>QWC</b>      | <b>* )</b>   | <p>A discussion including some of the following points</p> <ul style="list-style-type: none"> <li>• Both HEP and Solar power are renewable</li> <li>• Both HEP and Solar power would save fossil fuels</li> <li>• HEP only possible in some locations</li> <li>• HEP requires reservoirs and damming of rivers</li> <li>• This can damage environment /takes a lot of land out of use</li> <li>• Energy from solar power installation is currently much less than energy from fossil fuel powered station</li> <li>• Solar power only suitable in certain locations</li> <li>• Solar power reliability dependent on constant sunshine</li> <li>• Neither of them cause atmospheric pollution</li> </ul> | <b>(6)</b> |
| <b>Level</b>    | <b>0</b>     | No rewardable content   |            |
| <b>1</b>        | <b>1 - 2</b> | <ul style="list-style-type: none"> <li>• 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.</li> <li>• the answer communicates ideas using simple language and uses limited scientific terminology</li> <li>• spelling, punctuation and grammar are used with limited accuracy</li> </ul>   |            |
| <b>2</b>        | <b>3 - 4</b> | <ul style="list-style-type: none"> <li>• 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.</li> <li>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately</li> <li>• spelling, punctuation and grammar are used with some accuracy</li> </ul>  |            |
| <b>3</b>        | <b>5 - 6</b> | <ul style="list-style-type: none"> <li>• a detailed comparison such as one which relates advantages and disadvantages of <b>both</b> 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.</li> <li>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately</li> <li>• spelling, punctuation and grammar are used with few errors</li> </ul>      |            |