Mark scheme – Powering Earth (F)

Question			Answer/Indicative content	Marks	Guidance
1			**B** ✓	1 (AO2.1)	
			Total	**1**	
2			**B** ✓	1 (AO 2.1)	**Examiner's Comments** The majority of candidates found this question very challenging and did not recognise that the diagram showed a step-up transformer which would decrease the current in the secondary coil, and therefore decrease the power loss. Candidates also struggled to relate power loss to I2 x R. he most common incorrect answer was option C.
			Total	**1**	
3			**A** ✓	1 (AO 1.1)	
			Total	**1**	
4			**A** ✓	**1 (AO1.1)**	
			Total	**1**	
5			D	1	
			Total	**1**	
6			A	1	
			Total	**1**	
7		i	Simple use of P = V × I / idea of ratios using transformer equations (1) Current reduced by 16 times (1)	2	**ALLOW** current reduced (1)
		ii	Very large decrease in power loss (1) Power loss is related to the square of the current / **AW** (1)	2	
			Total	**4**	
8	a	i	Fossil fuel may run out / is non-renewable / be in short supply / become very costly ✓ **Named** damage to environment: Eg (increased) greenhouse gases /	**2** (AO3.1b) (AO3.1b)	**ALLOW** being used faster than being produced / finite resource **ALLOW** ice caps melting / droughts and storms / more polluting gases / other named polluting gases e.g. SO2 /

			global warming / sea levels rise / carbon dioxide / climate change / acid rain ✓		carbon emissions **IGNORE** just pollution or bad for the environment / more CFCs **Examiner's Comments** This question assessed AO3 and the majority of candidates gained at least 1 mark, usually for the idea that fossil fuels are not renewable. A significant number of candidates did not gain the second mark as their responses included statements about pollution that were too vague e.g. 'harmful emissions' or 'bad for the environment'. **Exemplar 2** 1. Fossil fuels are non-renewable and will eventually run out ✓ 2. Fossil fuels release lots of pollution, which causes damage to people and the planet [2] This response was credited with 1 mark for stating that fossil fuels are renewable. The second mark was not achieved as the candidate's statement that 'fossil fuels release lots of pollution' is not specific enough. To gain the second mark, the candidate should have referred to an appropriate scientific reason, for example more CO2 or more greenhouse gases.
		ii	To meet demand for electricity / not enough energy from renewable resources ✓ Less **named** damage to environment: (decreased) greenhouse gases / global warming / sea levels may fall / carbon dioxide / climate change / acid rain / ORA for coal ✓	**2** (AO1.2) (AO1.2)	**ALLOW** will not run out as fast (as coal) / to preserve fossil fuels / produces more energy (per kg than coal) **ALLOW** less polluting gases / carbon emissions / ice caps melting / droughts and storms **IGNORE** just less pollution or just better for the environment / less CFCs **Examiner's Comments** Although many candidates achieved 1 or 2 marks, a significant proportion did not gain any credit. Some candidates had the misconception that nuclear power is renewable. Others gave vague suggestions about 'damage to the environment'. Only the highest ability candidates usually gained full credit. **AfL** Candidates should be aware that in a Physics exam what they write will be assessed as a specific scientific response. Where candidates use unnamed, vague statements about 'pollution' or 'damage to the environment' these are unlikely to gain credit. For example graffiti, fly tipping and loud music are examples of pollution that are unlikely to be caused a power station.

	b	i	5.2 (billion tonnes oil equivalent) ✓	**1** (AO3.1a)	**ALLOW** answers between 5.0 and 5.5 **IGNORE** wrong units
		ii	Oil ✓	**1** (AO3.1a)	**Examiner's Comments** Part (a)(i) and (ii) assessed AO3 and required candidates to use estimated values from the graph. The majority of candidates were able to do this successfully.
		iii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 78 (%) award 2 marks** 8.3 / 10.6 (x 100) ✓ =78 (%) ✓	**2** (AO 2 × 3.1a)	**ALLOW** answers that round between 77(%) and 80(%) ✓✓ **ALLOW** 8.2 / 10.6 (x 100) OR 8.4 / 10.6 (x 100) OR 8.5 / 10.6 (x 100) OR answers that round between 0.77 and 0.80 **Examiner's Comments** This question required candidates to use estimated values from the graph to work out the amount of energy use due to fossil fuels and then convert their answer into a percentage of the total energy use. The question discriminated well as the lower ability candidates struggled to identify the proportion due to fossil fuel use. Many did not take into account all three of the fossil fuels which resulted in percentages that were much smaller than the expected answer. The higher ability candidates, who did identify the amount of energy use due to fossil fuels, were able to calculate the percentage correctly.
	c	i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.8 (kW) award 4 marks** $(P =) I^2 \times R$ ✓ 11 x 11 x 23 or 11^2 x 23 or 121 x 23 ✓ = 2783 ✓ Conversion to kW = 2.8 ✓	**4** (AO1.2) (AO2.1) (AO2.1) (AO2.1)	**ALLOW** 2.78 kW or 2.783 kW ✓✓✓✓ **ALLOW** equation in any form **ALLOW ECF** candidates answer to 3rd marking point converted to kW **Examiner's Comments** This question required candidates to recall the equation: *power = current² x resistance* before converting their answers into kW. Out of the candidates who gained credit, most were credited with all four marks. A few candidates were only credited with one mark for converting the power output in W into kW. A significant number of candidates used an incorrect

					equation for power, most commonly using *current* rather than *current*^{2} **AfL** When a physics question requires candidates to apply their mathematical skills they should always write down how they are answering the question. Using brief notes is and writing down intermediate calculations helps the examiner to see what the candidate is doing. A single finger error will result in many candidates receiving no credit because they only write down their final answer. Marks may be available for each stage of the process, using the correct equation, rearranging the equation, substituting in correct values. Choosing to access these compensatory marks by showing workings is good examination technique.
		ii	Wind speed varies / AW ✓	**1** (AO2.1)	**ALLOW** it depends on the strength of the wind / how windy it is / AW **IGNORE** there might not be any wind / wind changes direction / AW
		iii	(Idea of) not always enough wind / demand may exceed supply / AW ✓	**1** (AO2.1)	**ALLOW** (it) may not generate enough power / energy / AW **Examiner's Comments** Most candidates gained full credit for Q16(d)(ii) and (d)(iii). Those who did not gain credit often provided non-specific generalised reasons about the weather or the wind turbine 'breaking'.
	d	i	Step-up transformer ✓	**1** (AO1.1)	**Examiner's Comments** The majority of candidates correctly identified a step-up transformer. However, many lower ability candidates had less secure knowledge and suggested an inappropriate electrical device such as a voltmeter.
		ii	**Reduce** energy wastage / loss ✓	**1** (AO1.1)	**ALLOW** less heat loss / reduce current / reduce power loss / more useful power out / more efficient / less heating of wires **DO NOT ALLOW** no energy losses / prevent energy loss / AW **Examiner's Comments** This question is a direct assessment of on specification knowledge (P8.2d and P8.2e) that is in both separate Physics and Combined Science. However candidates across the ability range found it challenging and a minority of candidates correctly answered this lower demand question. **Misconception**

					Candidates have many misconceptions about transformers and why the voltage needs be increased. They referred to many incorrect ideas such as to make the energy move faster / further, to transfer enough power to homes and to reduce the resistance. Some candidates suggested that high voltages are used in the National Grid as this reduces energy losses during transmission to zero. **OCR support** There is a KS3–KS4 Transition Guide (J249) and a KS4–KS5 Transition Guide (H557) that offer support on teaching about generation of and distribution of the domestic electrical supply: http:/www.ocr.org.uk/Images/324646-electricity-ks3-ks4-transition-guide.pdf http:/www.ocr.org.uk/Images/309732-generating-electricity-transition-guide.pdf
		iii	d.c – (current / voltage / charge flow / it) has one direction or polarity ✓ a.c.- (current / voltage / charge flow / it) (continually) changes direction or polarity ✓	**2** (AO1.1) (AO1.1)	**ALLOW** dc only positive / only negative **IGNORE** electricity **ALLOW** current / voltage alternates OR positive and negative **Examiner's Comments** Most candidates gained at least 1 mark, usually for identifying a.c. as alternating current. Common misconceptions for d.c. included 'd.c. is constant' or 'd.c. goes straight to the device'.
			Total	**18**	
9	a		A.C. (transmitted in power lines) / (electrical/electron/particle) oscillations / AW ✓ **BUT** Alternating currents/(electrical/electron/particle) oscillations produce (radio) waves/electromagnetic radiation ✓✓	2 (AO2×1.1)	**Examiner's Comments** This Assessment Objective 1 question assessed candidates' knowledge and understanding of how radio waves are produced. This proved to be one of the most difficult questions on the paper but also discriminated well. Only the most able candidates gained marks for relating the production of radio waves to the oscillations of electrons in the transmission lines. **Misconception** Common misconceptions included radio waves being produced by something in the house or because the transmission lines produced heat.

	b		(High voltage means) lower current ✓ Less heating/heat loss/power loss/energy wasted or more useful energy transmitted / ORA ✓	2 (AO2×1.1)	**IGNORE** no energy losses / prevent energy loss / AW **ALLOW** more efficient / (wires at) lower temperature **Examiner's Comments** Although this question has been asked often in past GCSE Physics papers, over one quarter of candidates did not gain credit. Many gained 1 mark for the idea of less energy lost (as heat) but only the more able candidates were able to link this to higher voltages resulting in a lower current. **AfL** Candidates had many misconceptions about why energy should be transferred at high voltages. The responses often referred to incorrect ideas e.g. 'to make the energy move faster/further' or 'to transfer enough power to the home' or 'to reduce the resistance'. Candidates should also be aware that the idea of **NO** energy losses will not gain credit.
	c		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 20 (A) award 5 marks** Recall $I^2 = P / R$ ✓ 6.156 kW = 6156 W ✓ (I^2 =) 6156 / 15.39 **OR** (I^2=) 400 ✓ (I =) √400 ✓ (I =) 20 (A) ✓	2 (AO 1.2) (AO 2.1) (AO 2.1) (AO 2.1)	**ALLOW** correct equation in any form **DO NOT ALLOW** marks to be awarded from incorrect equation e.g. I = P / R Award marks if 6.156kW has not been correctly converted to W E.g. (I^2 =) 0.4 or 6.156/15.39 ✓✓ (I=) √0.4 ✓✓✓ I = 0.63 ✓✓✓✓ **Examiner's Comments** The majority of candidates scored either zero marks or 5 marks for this question. Over a quarter of candidates did not know the correct equation: power = (current)^2 x resistance. It was common to see an incorrect version of the equation (power = current x resistance) used instead. Some candidates did show their calculations and could therefore score 1 mark for converting kW into W.
			Total	**9**	
10			**Advantage - Any one from:** no carbon dioxide produced / does not contribute to global warming/climate change/acid rain / no polluting gases ✓	2 (AO 2×1.1)	**ALLOW** a named polluting gas **IGNORE** (idea of) ozone layer

			small quantities of fuel needed / (idea of) more energy per unit mass ✓ fuel readily available ✓ will not run out as fast (as fossil fuels) ✓ to preserve fossil fuels ✓ **Disadvantage - Any one from:** Radioactive/nuclear waste produced ✓ security of transport of fuel / waste ✓ expensive to build ✓ danger of exposure to radiation ✓ decommissioning is expensive ✓ risk of accident (and after-effects)/uncontrollable (chain reaction) ✓ non-renewable ✓		**ALLOW** (idea of) risk from terrorists **ALLOW** (idea of) explosion **IGNORE** just dangerous **Examiner's Comments** Most candidates gained at least 1 mark, usually for identifying a disadvantage of nuclear power. Poor communication skills were an issue for many candidates and vague answers such as 'no pollution', 'produces waste', 'produces more energy' and 'expensive' did not gain any credit.
			Total	**2**	
11		i	230 (V) ✓	1 (AO1.1)	
		ii	(Earth wire together with fuse) prevents user from getting electric shock (if there is a fault) ✓ Plastic case is an insulator (so earth wire not required) ✓	2 (AO2 × 1.1)	**ALLOW** metal case could cause electric shock if no earth wire / AW **ALLOW** idea of earth wire carries current to Earth / AW **ALLOW** prevents projector becoming live / AW **ALLOW** plastic case is not a conductor / does not conduct electricity/current **ALLOW** appliance is double insulated
			Total	**3**	
12			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed evaluation of the advantages and disadvantages of wind power **AND**	6 (AO2 × 1.1) (AO2 × 3.1a) (AO3 × 3.2b)	**AO1.1 Demonstrates knowledge and understanding of advantages and disadvantages of wind power** Advantages • Wind is renewable • Does not create greenhouse gases (CO_2) • Does not contribute to global warming/climate change • Cheap to run (once built) • Less fossil fuels used

			Analysis of Fig. 18.1 and Fig. 18.2 **AND** An attempt to give a conclusion about the use of wind power *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Evaluation of the advantages and disadvantages of wind power **AND** Analysis of Fig. 18.1 and Fig. 18.2 **OR** Evaluation of the advantages and disadvantages of wind power **AND** An attempt to give a conclusion about the use of wind power **OR** Analysis of Fig. 18.1 and Fig. 18.2 **AND** An attempt to give a conclusion about the use of wind power *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Evaluation of the advantages or disadvantages of wind power **OR** Analysis of Fig. 18.1 or Fig. 18.2 **OR** An attempt to give a basic conclusion about the use of wind power *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** No response or no response worthy of credit.		Disadvantages • Unreliable – when wind drops so does power output / turbines switched off if it is too windy • Takes up lots of land • Some people think they are unsightly/noisy • Expensive to build **AO3.1a Analyses information by interpreting graphs of power output and use** • Wind pattern/power generated does not follow demand • Power generation is (always) below that of demand • Demand peaks at 17.00, lowest at ~5.00 • Peak demand is ~48000MW or Lowest demand is ~27000MW • Greatest power generation is ~11000MW or lowest power generation is ~5300MW • Power generation fluctuates **AO3.2b Analyses information to draw conclusions about use of wind power** • Current wind power cannot meet the demand for the UK • To meet the demand lots more wind turbines need to be built • Even more land/sea will be taken up with wind turbines • Expensive to build as so many wind turbines required • There will still be some days when wind cannot meet the demand requirements • There will need to be other power generation systems (examples given) • We need to be able to store the energy generated
			Total	**6**	

13			**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.9 (A) award 2 marks** (Rearrangement: I_p =) $I_s \times V_s / V_p$ ✓ **OR** (I_p =) 12 × 9.0 / 120 ✓ (I_p =) 0.9 (A) ✓	2 (AO1.2) (AO2.1)	
			Total	**2**	