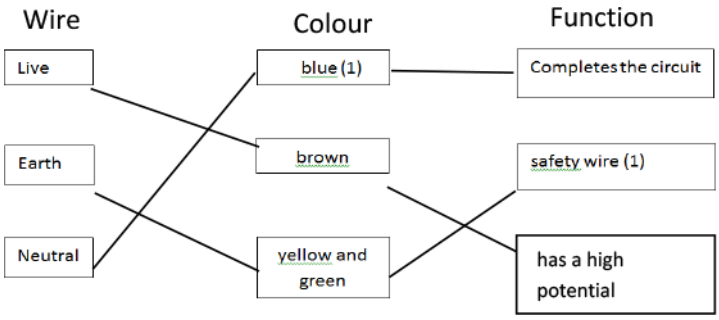
Mark scheme – Powering Earth (F)

Question			Answer/Indicative content	Marks	Guidance
1			**A** ✓	1 (AO1.1)	
			Total	**1**	
2			**D** ✓	1 (AO2.2)	
			Total	**1**	
3			**B** ✓	1 (AO1.1)	**Examiner's Comments** Candidates generally realised that the reason was to reduce heating in wires but were confused with whether the voltage was high and the current low or the voltage was low and the current was high.
			Total	**1**	
4			**A** ✓	1 (AO2.1)	**Examiner's Comments** This question initially looks straightforward. A and D are both step-up transformers since the p.d. has increased in the secondary coil. However, in D the output power is also greater than the input power which means that the transformer would be more than 100% efficient. **AfL** In these types of questions, candidates should be encouraged to work through each response perhaps indicating with a small cross any responses that can be eliminated. They should then work out each of the remaining responses. In this question, B and C could

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>be eliminated since B is a set-down transformer and in C the p.d. remains the same. Then the power input could then be calculated for the remaining primary and secondary coils writing the values to the left and right of each row in the table.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>5</td><td></td><td></td><td>C ✓</td><td>1
(AO1.1)</td><td><u>Examiner's Comments</u>

This first question was a simple recall question. Candidates are expected to know that mains electricity is a.c. (ruling out options B and D) and candidates should be able to recall that the domestic supply in the UK is a.c. at 50 Hz and about 230 V.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>6</td><td></td><td></td><td>B ✓</td><td>1
(AO1.1)</td><td><u>Examiner's Comments</u>

Candidates found this question very challenging. It tested whether candidates understood that direct current was a flow in one direction. A large number of candidates incorrectly gave response C presumably since they thought that this demonstrated a constant potential difference. The correct response shows a varying direct current.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>7</td><td>a</td><td></td><td>Increases output potential difference (1)</td><td>1</td><td></td></tr>
<tr><td></td><td>b</td><td></td><td><table><tr><th>Fuel</th><th>Type</th></tr><tr><td>Wood</td><td>renewable</td></tr><tr><td>Plant and vegetable oils</td><td>renewable</td></tr><tr><td>Peat</td><td>non-renewable</td></tr><tr><td>Coal</td><td>Renewable (x) (1)</td></tr><tr><td>North Sea gas</td><td>non-renewable</td></tr><tr><td>Uranium</td><td>renewable (x) (1)</td></tr></table></td><td>2</td><td>ALLOW the answer to be checked on the fuel side.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>3</td><td></td></tr>
<tr><td>8</td><td></td><td></td><td>C</td><td>1</td><td></td></tr>
</table>

			Total	**1**	
9			A	1	
			Total	**1**	
10	a		 Correct matching of wires to colours (1) Correct matching of colours to functions (1)	4	
	b		more can be grown / **AW** (1)	1	
			Total	**5**	
11	a	i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.8 (kW) award 4 marks** (P =) $I^2 \times R$ ✓ 11 × 11 × 23 or 112 × 23 or 121 × 23 ✓ = 2783 ✓ Conversion to kW = 2.8 (kW) ✓	**4** **(AO 1.2)** **(AO 2.1)** **(AO 2.1)** **(AO 2.1)**	**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** Q23 is an overlap question with J249/04 and candidates found it very challenging with only a small number of the most able candidates being credited with any marks. From the stem of the question candidates knew that their answer needed to be between 1.0 kW and 3.0 kW. There were compensatory marks available where candidates wrote down the equation they were using and the different stages of their calculations. The most common workings shown were 11 × 23 or 23 ÷

					11, rather than 112 × 23 = 2.78kW. .
		ii	Wind speed varies / AW ✓	**1 (AO 2.1)**	**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 **Examiner's Comments** Many candidates realised that the wind speed would vary, but most responses were vague statements about the 'weather'.
		iii	(Idea of) not always enough wind / demand may exceed supply / AW ✓	**1 (AO 2.1)**	**ALLOW** (it) may not generate enough power / energy / AW **Examiner's Comments** Two thirds of the candidates reasoned that there may not be enough wind of the required speed or that a 3.0 kW wind turbine would not be sufficient to power a household. **AfL** It is very important to show candidates how to focus their answers on the question that they are being asked. For example, this question was about whether 'just one wind turbine' could be a reliable source of power a house. However, many candidates answered a question about the impact of a domestic electrical supply failure, which would apply to any source of power to a house.
	b	i	Step-up transformer ✓	**1 (AO 1.1)**	**Examiner's Comments** One in six candidates did mention transformers. Step-up and step-down transformers are on specification knowledge (P8.2d) and candidates should know the difference that step-up transformers are used to

					increase the voltage distributed by power line.
		ii	**Reduce** energy wastage / loss ✓	**1 (AO 1.1)**	**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 required candidates to apply their understanding of the National Grid from P8.2e. Only the most able candidates recalled that the higher voltage reduces energy losses but does not eliminate them. Some candidates stated that higher voltages allowed more power to be produced.
		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 (AO 1.1)** **(AO 1.1)**	**ALLOW** dc only positive / only negative **IGNORE** electricity **ALLOW** current / voltage alternates OR positive and negative **Examiner's Comments** Only the most able candidates were able to answer this question explaining both the differences in the direction of the current flow and the polarity of the voltage. **Misconception** Most candidates' knowledge and understanding of a.c. and d.c. electrical supply is quite vague, and often only understood in terms of 'different directions' but not how this relates to the flow of current nor to the polarity of the voltage.

	c	i	Fossil fuel may run out / is non-renewable / be in short supply / become very costly ✓ **Named** damage to environment: Eg (increased) greenhouse gases / global warming / sea levels rise / carbon dioxide / climate change / acid rain ✓	**2 (AO 3.1b)** **(AO 3.1b)**	**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. SO_2 / carbon emissions **IGNORE** just pollution or bad for the environment / more CFCs **Examiner's Comments** Most candidates recognised that fossil fuels may run out or be in short supply or stating that they are non-renewable. However, fewer candidates went on to give specific scientific reasons for scientists concerns that were creditable. Most candidates gave generalised responses about fossil fuels damaging the environment or causing 'pollution'.
		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 (AO 1.2)** **(AO 1.2)**	**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** Higher ability candidates said that there were not enough renewable energy resources and nuclear power stations would assist in meeting the demand for electricity, or help in preserving fossil fuels. Answers which gave detail about less damage to the environment were also credited, although a number of candidates thought that nuclear power stations would

					not cause any potential damage to the environment.
	d	i	5.2 (billion tonnes oil equivalent) ✓	**1 (AO 3.1a)**	**ALLOW** answers between 5.0 and 5.5 **IGNORE** wrong units **Examiner's Comments** Many candidates found it difficult to interrogate the stacked line graph and many candidates stated the total energy use in 1971 rather than the increase from 1971 to 2003. As the vertical scale on the graph was only marked at 1 billion tonne increments candidates were allowed to give an answer between 5.0 and 5.5 billion tonnes (oil equivalent).
		ii	Oil ✓	**1 (AO 3.1a)**	**Examiner's Comments** Most candidates correctly identified oil as the greatest use. Other candidates suggested coal or renewables.
		iii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 78 (%) award 2 marks** 8.3 / 10.6 (× 100) ✓ =78 (%) ✓	**2 (AO 2 x 3.1a)**	**ALLOW** answers that round between 77(%) and 80(%) ✓✓ **ALLOW** 8.2 / 10.6 (× 100) OR 8.4 / 10.6 (× 100) OR 8.5 / 10.6 (× 100) OR answers that round between 0.77 and 0.80 **Examiner's Comments** Only around 10% of candidates were able to answer this question fully and most other candidates were not credited with any marks. Many candidates struggled to identify coal, oil and gas as fossil fuels. Those less able candidates that attempted to show their working were could be credited with a compensatory mark.
			Total	**18**	
12			**Any one from:** supplies of uranium are large enough / will not run out to consider it renewable / AW ✓	1 (AO 2.1)	**Examiner's Comments** Many candidates incorrectly referred to fusion rather than fission. Candidates are advised to underline key

			Uranium is not being replaced / used quicker than it is being replaced to consider it non-renewable		phrases in the question paper before answering the question. Many candidates answered the question in terms of the dangerous waste products or that the waste products could be re-used. Candidates had the opportunity to explain why either of the scientists could be correct in terms of the supplies of uranium being large enough so will not run out and therefore renewable or that the uranium is not being replaced so non-renewable.
			Total	**1**	
13		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**	