OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



MARK SCHEME

P8.2 POWERING EARTH

SCORE	PERCENTAGE
/225	%

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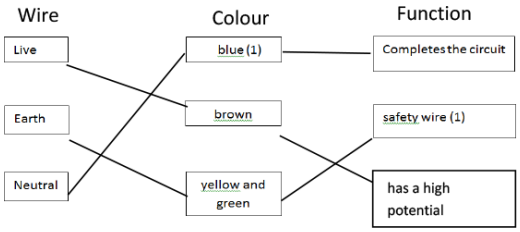
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<tr><td>2</td><td></td><td></td><td>C</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>3</td><td>a</td><td></td><td>more can be grown / AW (1)</td><td>1</td><td></td></tr>
<tr><td></td><td>b</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>c</td><td></td><td>Increases output potential difference (1)</td><td>1</td><td></td></tr>
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Correct matching of wires to colours (1)

Correct matching of colours to functions (1)</td><td>4</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>8</td><td></td></tr>
<tr><td>4</td><td></td><td></td><td>D</td><td>1</td><td></td></tr>
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<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>6</td><td></td><td>i</td><td>Simple use of P = V × I / idea of ratios using transformer equations (1)

Current reduced by 16 times (1)</td><td>2</td><td>ALLOW current reduced (1)</td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
		ii	Very large decrease in power loss (1) Power loss is related to the square of the current / **AW** (1)	2	
			Total	**4**	
7		i	1 solar (1) 2 bio diesel (1)	2	**one mark for each correct answer, either order** **for either mark allow electric or** battery [1] ethanol or bio-ethanol or bio-fuel for bio diesel [1] Examiner's Comments The majority of candidates correctly gave solar and electricity as alternatives to fossil fuels.
		ii	**any one from** idea that we don't get enough sunlight to power a car (1) bio-fuels are difficult to find / few garages sell bio-fuel (1) few charging points for battery / limited range for battery / batteries take too long to charge (1)	1	Examiner's Comments The most common one not thought to be suitable was solar with a reason that we do not get much sun in the UK.
			Total	**3**	

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Question			Answer/Indicative content	Marks	Guidance
8			Level 3: (5–6 marks) Answer shows how both ideas can be maximised AND how this will help the environment. Quality of written communication does not impede communication of the science at this level. Level 2: (3–4 marks) Answer shows how both ideas can be used OR one idea used and maximised AND how this will help the environment. Quality of written communication partly impedes communication of the science at this level. Level 1: (1–2 marks) Answer shows how one idea can be used OR how it helps the environment. Quality of written communication impedes communication of the science at this level. Level 0: (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.	6	This question is targeted up to grade C Indicative scientific points may include: maximise output: • large area windows / large area conservatory / large area panels • windows / panels face Sun or south • panel tracks Sun • use most efficient photocells possible helping environment: • less fossil fuels needed • no polluting waste • less CO_2 or SO_2 or acid rain • less nuclear fuel used using the ideas: • photocells / solar panels need sunlight • photocells convert light to electricity • photocells / solar panels on roof / AW • windows let in radiation / AW • heat (energy) trapped in house • passive heating of water possible Use the L1, L2, L3 annotations in Scoris; do not use ticks. <u>Examiner's Comments</u> This was a 6-mark question targeted at up to grade C. The question asked about 4 things: passive solar heating, photo cells, how to maximise the energy collected and how this helps the environment. The majority of candidates made relevant statements about using photo cells and several explained that the output could be maximised by putting them on the south side of a building and increasing the area. A few candidates added that there would be reduced use of fossil fuels at power stations. It was rare to see any comment

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Question			Answer/Indicative content	Marks	Guidance
					about passive solar heating.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
9	a		**any two for one mark** coal / oil / gas [1]	1	**two fossil fuels required in either order for one mark** **ignore** peat **allow** crude oil but **not** incorrect fractions eg. petrol Examiner's Comments Most candidates were able to name two fossil fuels used in power stations, although a significant number of candidates thought that petrol was used in power stations.
	b		**any one from** wood (chips) [1] straw [1] manure [1] biomass [1] methane [1]	1	**ignore** nuclear fuel allow household waste [1] Examiner's Comments Very few candidates correctly named a renewable fuel used in power stations. The majority gave renewable energy sources such as wind and solar.
	c		**for one mark** (.... power lines called the) national grid [1] **any two for one mark** (.... to consumers such as) homes / factories / offices / farms / schools / buildings / shops / etc [1]	2	**allow** electricity grid / electrical grid / distribution grid [1] **two consumers required in either order for one mark** Examiner's Comments Almost half the candidates knew that the system of power lines is called the National Grid but the majority knew that it connected to consumers such as homes or factories. Examiners credited any correct consumer building.
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
10			lowers current [1] reduces heating effect (in wires) [1]	2	 **Ignore** less energy is lost. **Allow** less heat loss [1] **Allow** correct use of I^2R **Examiner's Comments** About a third stated that the current was lower (at high voltages) [1] so that less heat was wasted [1]. Some answered well using I^2R to illustrate the marking points [2].
			Total	**2**	
11		i	4 [2] **but if answer is incorrect** $\frac{7300}{5 \times 365}$ [1]	2	**Examiner's Comments** Most calculated the family size to be 4 [1]. A few candidates however, gave wrong (and unreasonable answers) of family sizes into the many thousands. If these had re-read the question and judged if their answers were reasonable (for the size of one family) then they may have re-checked there arithmetic and gained the marks.
		ii	(idea of) more people in UK or less people in Belgium [1]	1	**allow** different populations [1] **allow** justified examples e.g. industry use in UK is higher [1] Belgium uses more gas / wastes less energy [1] (idea that) Belgium uses more efficient appliances (than the UK) [1] **Eg.** Belgium uses more LEDs than the UK [1] **Allow** other sources of power used. Eg solar heating of water [1] **Examiner's Comments** This part of the question was common with the foundation paper (B752-01). Most referred correctly to the lower population in Belgium [1].
			Total	**6**	

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Question			Answer/Indicative content	Marks	Guidance
12			risk of electrocution / (severe) shock / death [1] **benefit** reduces power / heat / energy loss [1]	2	**NOT** merely (causes more) damage / more dangerous **ignore** heating of wires as a risk **allow** other sensible risks if qualified **allow** conserves fuel resources / reduces costs for the power company / more efficient [1] **ignore** more power transmitted / lower current **Examiner's Comments** Most answers referred to less energy wasted or more efficient for [1] mark. Others also added the increased risk of electrocution [1]. Some were vague by saying high voltage was dangerous or too high a voltage for the home.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
13			[Level 3] Explains all three from: -why the plug only needs two wires -explains why the plug needs a fuse -why the fuse is 13A (rather than 3A). Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Explains two from: -why the plug only needs two wires -explains why the plug needs a fuse -why the fuse is 13A (rather than 3A). Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Explains one from: -why the plug only needs two wires -explains why the plug needs a fuse -why the fuse is 13A (rather than 3A). Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to B. Description about why the 13A fuse is important: • 13 A fuse is above the normal working current for the hairdryer / the normal working current of the hair dryer is less than 13 A • 3A fuse would blow under normal use as more current is required by hairdryer • correct explanation using power = voltage × current to choose the correct fuse Why a fuse is needed: • idea that fuse melts if too much current flows • safety reason explained e.g. a small increase in the normal current will cause the fuse to melt / blow so very high current due to a fault will not happen. Eg. too large a current causes the fuse (wire) to melt / blow • reduces the risk of fire (if the hair dryer develops a fault) eg. prevents the flex / hair dryer overheating / causing a fire Why the plug only needs two wires: • earth wire not needed • only needs live and neutral wires • the hair dryer is double insulated / has a plastic case / has no touchable metal parts • the plastic case is an insulator / non conductor / cannot become live Use the L1, L2, L3 annotations if needed; do not use ticks. Examiner's Comments This level of response 6-mark question on

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Question			Answer/Indicative content	Marks	Guidance
					household plugs and fuses was quite well answered. It was targeted at grades D up to B. It gave a full spread of marks with just over half of answers scoring 4 or more marks. Weaker answers that the two wires required were earth and live. Other weak answers often only said that the earth wire was not needed but failed to develop the answer further. There were some good answers in terms of double insulation and the plastic insulating case being unable to become live. There were some misconceptions such as the wire is double insulated. Also some poorly communicated phrases such as the fuse breaks or goes (rather than melts or blows) were commonplace. Also fuses blowing with too much voltage was quite common. Only a few mentioned fire risk. Candidates often said that the current was below 13A but did not clearly say that current was (or needed to be) above 3A. Voltage, current and power were used interchangeably and some candidates were confused over a fuse heating up (and melting) and the hairdryer itself heating up. However, the question attracted many answers which were worthy and contained good physics.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
14		i	140 (kWh) [2] but if answer is incorrect 5 × 4 × 7 scores [1]	2	 also if answer is incorrect or incomplete then as an alternative allow: 28 × 5 or 20 × 7 [1] Examiner's Comments This data question on electrical energy usage across Europe was answered well across the full range of candidates. Almost all calculated energy usage in kWh
		ii	Austria [1] Germany [1]	2	any order if more than two countries then deduct [1] for each incorrect response e.g. Austria, Germany, UK [1] Austria, UK [1] Austria , UK, Sweden [0] Examiner's Comments This data question on electrical energy usage across Europe was answered well across the full range of candidates. Almost all correctly selected Austria and Germany. A very small number gave more than 2 countries and so were penalised for doing so.

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Question			Answer/Indicative content	Marks	Guidance
		iii	others will be using more than 20.5kWh /AW [1]	1	**allow** some will use more and some will use less [1] **allow** it is an average so people use more or less [1] **ignore** it is just an average **ignore** people do not use the same **Examiner's Comments** This data question on electrical energy usage across Europe was answered well across the full range of candidates. Most could not explain that there will be some users above as well as below the mean.
		iv	(idea of) more people in UK or less people in Belgium [1]	1	**allow** different populations [1] **allow** justified examples e.g. industry use in UK is higher [1] Belgium uses more gas / wastes less energy [1] (idea that) Belgium uses more efficient appliances (than the UK) [1] **Eg.** Belgium uses more LEDs than the UK [1] **Allow** other sources of power used. Eg solar heating of water [1] **Examiner's Comments** This data question on electrical energy usage across Europe was answered well across the full range of candidates. Most scored 1 for the idea that Belgium had a lower population
			Total	6	
15			**B** and **C** [1] (idea that) the output voltage is higher than the input voltage / ora [1]	1	**both** required in either order **Examiner's Comments** Most candidates could identify errors in a table of step up and step down transformers. Only the lowest ability candidates found this question challenging.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
16			box next to 50Hz ticked [1]	1	**allow** any indication of the correct answer more than one box ticked = 0 marks **Examiner's Comments** This question on ac and half wave rectification produced the best and worst responses to questions in the whole paper. Most could recall that UK mains is 50Hz.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
17			Level 3: (5 – 6 marks) Correct statement regarding acceleration in vertical OR horizontal direction AND compares trajectories or relative speeds. Quality of written communication does not impede communication of the science at this level. Level 2: (3 – 4 marks) Answer compares the speeds of marbles with a reason AND compares the trajectories Quality of written communication partly impedes communication of the science at this level. Level 1: (1 – 2 marks) Answer compares the speeds of marbles OR describes the trajectories simply. Quality of written communication impedes communication of the science at this level. Level 0: (0 marks) Insufficient or irrelevant science. Answer not worthy of credit	6	This question is targeted up to grade C To reach Level 3 a correct statement regarding acceleration in at least one direction is needed Indicative scientific points may include: Describing the accelerations • no horizontal acceleration • there is constant vertical acceleration Comparing trajectories • paths are parabolic • path V3 is more curved as it is moving faster (horizontally) Comparing speeds • V1 slowest / V3 fastest / AW • because V3 travels furthest Simple description of trajectory • curved paths Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This 6 mark level of response question trajectories was targeted at grade C. This question gave a good range of marks and discriminated well across the candidature. Most could compare the different speeds of the object in each trajectory. Higher ability candidates often achieved a Level 2 by describing that the faster object travelled further or by describing the parabolic shape. Responses that could describe accurately the horizontal and vertical accelerations of the projectile were very rare.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
18		i	any one from both heat water / both produce steam [1] both have turbines [1] both use a generator (to generate electricity) [1]	1	**ignore** nuclear 'fuel burns' **ignore** merely 'different fuels used' **ignore** just generate electricity Examiner's Comments This question on electricity generation was quite well answered across the full range of candidates. Most scored at least 2 out of 4 marks. Most could identify a similarity between coal fired and nuclear power station.
		ii	any one from (nuclear power stations) use uranium [1] (nuclear power stations) use a nuclear reaction / coal burns but nuclear does not [1] (nuclear power stations) have a reactor / (nuclear power stations) do not have a furnace [1] (nuclear power stations) do not produce (named) greenhouse gases [1] (nuclear power stations) produce radioactive waste [1]	1	**allow** plutonium or thorium [1] **ignore** just 'different fuel Examiner's Comments This question on electricity generation was quite well answered across the full range of candidates. Most scored at least 2 out of 4 marks. Only higher ability candidates tended to describe differences between the two types
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
19			(Level 3) Identifies the correct colour coding AND describes why a 13A fuse is important AND how the fuse operates. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Must have at least 2 from Identifies the correct colour coding OR recognises that no earth wire is required OR describes why a 13A fuse is important. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Identifies the correct colour coding OR recognises that no earth wire is required OR basic understanding of a fuse. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C. Description about why the 13A fuse is important: • prevents further damage to hairdryer • 13A fuse is just above the normal working current for the hairdryer • a smaller fuse would blow Description about how the fuse operates: • currents above 13A cause the fuse to melt • this prevents current flow • disconnects from mains voltage Basic description of fuse • stops overloading • reduces risk of fire Recognises that no earth wire is required: • only two wires drawn on diagram / only two wires are needed • written indication that no earth wire is required e.g. no need to earth / no green-yellow wire Identification of the colour coding: • live is brown • neutral is blue Use the L1, L2, L3 annotations in scoris. Do not use ticks. This 6 mark level of response question describing how to wire a plug for a double insulated hairdryer and to describe the importance of a fuse was not well answered. The question was targeted up to grade C. Many could recall colour coding to reach Level 1, some recognised that the earth wire was not needed and only the highest ability candidates could accurately describe the need for a 13 Amp fuse. This

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Question			Answer/Indicative content	Marks	Guidance
					question was surprisingly challenging as the material is very familiar but the move to a less structured question proved to be challenging this year.
			Total	6	
20			(step down) transformer [1]	1	**ignore** type of transformer Examiner's Comments Only about 25% of candidates correctly identified the device that reduces mains voltage as a transformer.
			Total	1	

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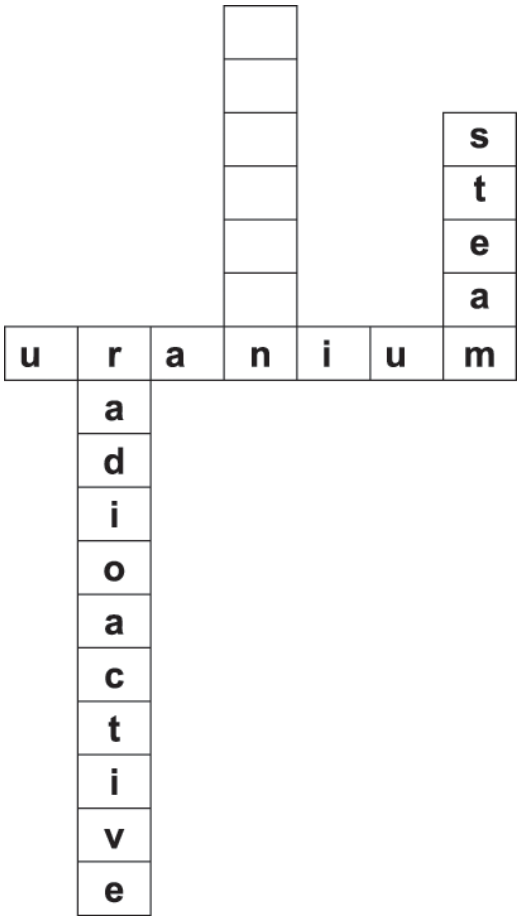
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Question			Answer/Indicative content	Marks	Guidance
21	a		circuit contains diode (1) **then** only allows current in one direction / AW (1) **but** diode connected wrong way in circuit (2)	2	**allow** diode labelled on diagram **allow** the  is the wrong way round (1) **allow** cells / battery wrong way round (1) **Examiner's Comments** Very few candidates identified the diode or knew its purpose. Many thought that the diode was a NOT gate. Some misunderstood the symbol for a battery as providing a gap in the complete circuit.
	b		idea of half wave rectification / current only flows half of the time / current only flows part of the time (1)	1	**allow** the current is changing direction / the current is going back and forth **ignore** just the current is alternating / it is an alternating current **ignore** the current changes **Examiner's Comments** Almost no candidates had any understanding of the role of the diode in half wave rectification.
			Total	3	
22			<table><tr><th>step up</th><th>step down</th><th>isolating</th></tr><tr><td>(✓)</td><td></td><td></td></tr><tr><td></td><td>✓</td><td></td></tr><tr><td></td><td></td><td>✓</td></tr><tr><td></td><td>✓</td><td></td></tr><tr><td>✓</td><td></td><td></td></tr><tr><td colspan="3">(2)</td></tr></table>	2	**all** correct (2) 2 or 3 correct (1) **Examiner's Comments** Most candidates showed a good grasp of the structure of different types of transformer to gain both marks.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
23			 (2)	2	answers in crossword take precedent but if crossword blank **allow** answers next to the clues 1 or 2 correct = 1 mark 3 correct = 2 marks **Examiner's Comments** Most candidates achieved at least 1 mark and about a third achieved 2 marks. Lack of knowledge of uranium as nuclear fuel and that nuclear waste was recycled (rather than radioactive) frequently prevented the gaining of 2 marks.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
24	a	i	iron / soft iron / laminated (core) secondary (coil) primary (coil) step-down	2	4 correct = 2 marks 2 or 3 correct = 1 mark Examiner's Comments The labelling of the transformer was done correctly by about 50%. Common incorrect responses were 'inner' core and step-up transformer.
		ii	375 (V) (2) but if calculation incorrect $\frac{10\,000}{\text{output}} = \frac{4000}{150}$ (1)	2	Allow 374.5 to 376 [2] $\left[\frac{4000}{150}\right]$ = 26.6(67) / 26.7 [1] allow correct versions of this substituted equation e.g. output × 4000 = 10 000 × 150 (1) Examiner's Comments The calculation was better answered than in previous years. Many got full marks here with partial answers (26.6 – missing the final step) gaining one mark.
	b		AC produces a **changing** magnetic field (1) a changing magnetic field produces a changing voltage / current in the coil (1) if no marks scored electromagnetic induction (only happens with AC) [1]	2	**allow** DC does not produce a changing magnetic field (1) **allow** idea of changing magnetic field needed for **any** voltage / current to be induced (1) Examiner's Comments The question asked candidates to explain why transformers require AC. It proved challenging for many who failed to mention the changing magnetic field.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
25			any two from transformers can be used to change voltage or increase voltage or decrease voltage (1) 110 000 V is dangerous or make the **voltage** safer for people (in their homes) (1) less power loss (at high voltages) or more efficient (at high voltages) (1)	2	**allow** idea of a step up transformer for increasing voltage from power station to power lines (1) **allow** idea of a step down transformer for decreasing voltage from power lines to house for safety (1) **allow** higher level answers e.g. increases the efficiency because it lowers the current (2) Examiner's Comments ??Very few candidates could explain why transformers improve electricity transfer. Frequently answers lacked clarity and made the most vague references to increased safety (and on many occasions preventing appliances from blowing up).
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
26			yes / no (no mark) **any three from** idea that CO_2 **produced** when biofuel made (1) carbon dioxide is given out (when fuel burns) (1) (biofuel is made from) plants / animals / living things (1) (plants) photosynthesise [1] carbon neutral (1)	3	**Allow trees [1]** **but** plants photosynthesize (2) **allow** plants take in carbon dioxide when they grow (2) **Award marks for combining marking points:** eg. 'CO_2 given out (by fuel) compensated by photosynthesis [2] Eg. carbon dioxide given out when fuel burns = carbon dioxide taken in by plants [3] Examiner's Comments The first question on section C module P1 was about speed and has 10 marks in total. There were some excellent responses about biofuels, which covered all marking points showing a secure understanding of the issues and processes. One common misconception though with weaker answers was that 'biofuels do not produce CO_2 when burned'. Concise answers such a 'plants take in CO_2 when growing and give out CO_2 when burned shows that they are carbon neutral' where quite common.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
27	a		**Idea that:** water heated / steam is produced / fuels release heat / AW (1)	1	**allow** Heat energy is used (to produce electricity) (1) **ignore** burning Heat unqualified = 0 fuel is heated = 0 **Examiner's Comments** Most candidates understood that a thermal power station involved heat.
	b		renewable energy (1) less polluting gases (1) fossil fuels finite (1)	1	**allow** reduces CO_2 output / greenhouse gases (1) **allow** fossil fuels are running out (1) **allow** no fuel costs (1) **not** just environmentally friendly **Examiner's Comments** Most candidates produced the standard answers of renewable energy, less polluting gases, less use of fossil fuels.
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
28			Level 3: (5 – 6 marks) fuel power station AND pumped storage system linked together with demand Quality of written communication does not impede communication of the science at this level. Level 2: (3 – 4 marks) fuel power station OR pumped storage system linked together with demand Quality of written communication partly impedes communication of the science at this level. Level 1: (1 – 2 marks) sensible comment about the system Quality of written communication impedes communication of the science at this level. Level 0: (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.	6	This question is targeted up to grade A* Indicative scientific points may include: fuel power station (on own) difficulty in stopping and starting fuel power stations generates electricity all (or most of) the time at a steady rate cannot store electricity pumped storage system (together with fuel power station) with pump storage system it can store surplus energy energy stored off peak or when demand is low / in the middle of the night. with pump storage system it can generate electricity when needed water released when extra energy needed at high or peak demand changes in demand can cope with surges in demand (idea that there is) a (relatively fast) response time to demand less likely to result in power cuts (when demand is greater than steady supply) (idea that) energy not ‘wasted’ so cheaper for both consumers and producers saves the need to redistribute energy using the national Grid Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question ,worth six marks, was about a pumped storage system. There was some confusion as to how this system worked even though the basic operation was given in the question. Weaker candidates thought it replaced conventional power stations when demand was low. The majority of candidates, however, reached level 2 with about 10% going on to reach level 3. Candidates were

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Question			Answer/Indicative content	Marks	Guidance
					able to comment generally on the system and link either the power station to the pumped storage system to demand. Few candidates linked the two systems together: when demand for electricity was low, energy was stored in a high level reservoir and when demand was high, this stored water was used to generate electricity.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
29	a		**Risk max 1** radiation **leak / leak** of nuclear material / **leak** of nuclear waste (1) power station / reactor may get damaged / attacked by terrorist / earthquake (1) radiation sickness / poisoning (1) **how the risk is reduced / managed max 1** monitor people (for contamination) (1) monitor radiation around the nuclear power station (1) safe storage or disposal of nuclear materials (1) idea of better control of reactor (1) better shielding against radiation loss (1) have good shut down / emergency procedures (1) extra protection if in earthquake risk area (1) better security at nuclear power station (1)	2	**ignore** power stations emit radiation **allow** correct examples such as radioactive materials stored (deep) underground / encased in (thick) concrete / lead (1) **allow** correct examples such as surround the reactor with (thick) concrete walls (1) **Examiner's Comments** This HSW question focussed on the risks of nuclear power generation and how to reduce these risks. Most candidates mistakenly thought that nuclear power stations continuously emit dangerous levels of radiation. Better answers described ‘leaks’ or ‘reactor problems that allowed radiation to escape’. Management of this risk such as creating a no-go area in such an emergency gained 1. Nuclear waste being buried in glass deep underground was also a common correct answer.

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Question			Answer/Indicative content	Marks	Guidance
	b		idea of voltage change (1) but voltage increase / steps up voltage (2) **reduces** energy loss / **reduce** the cost (1)	3	**allow** higher level answers e.g. idea of current change (1) but to reduce current (2) **allow** voltage reduces (1) **allow** reduces power loss (1) **allow** increases efficiency (1) **ignore** stops energy loss **Examiner's Comments** Many knew that these transformers changed the voltage and most stated that the voltage increased or was stepped-up voltage. Rather fewer went on to say that this was more efficient or wasted less energy. Examiners did not allow stops energy loss as an answer. The question specifically asked about the transformers that connected power stations to the National Grid. A significant number of candidates went on to write about the whole of the National Grid and the use of step down transformers to supply electrical energy to the home. Provided the first part was correct these were not penalised but wasted time in giving their answer. This question about nuclear power generation included one question about How Science Works and another on transformers.
			Total	5	

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Question			Answer/Indicative content	Marks	Guidance
30			idea that readings change each side of the 0 / idea that readings are positive and negative or flow in two directions (during a cycle) / AW (1)	1	**ignore** merely up and down / same frequency, etc. **ignore** merely 'all have peaks and troughs' **allow** all change (in) direction (1) **allow** all change from + to ? (1) Examiner's Comments This was quite well answered with most answers referring to positive and negative or different directions of supply. Vague answers described the signals as varying and some mistakenly explained in terms of having the same wavelength, frequency etc. Weaker answers described peaks and troughs or up and down and did not get the mark.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
31	a		any two from: idea of renewable energy (1) idea of no polluting waste produced (1) crops can be grown under them / placed at sea (1) useful in remote locations (1) (idea that) new technology are making wind turbines more efficient (than conventional power stations) (1)	2	**allow** does not need fossil fuels or named fossil fuel (1) **allow** no carbon dioxide produced / no greenhouse gases (1) allow idea of less global warming (1) **allow** idea of less maintenance / labour or staff required (1) **allow** generation close to consumer / AW (1) **ignore** pollution unless qualified Examiner's Comments This question on wind turbines was generally well answered although quite a few gave the disadvantages of coal powered stations rather than the advantages of wind power. The ideas of renewable energy and no greenhouse gases were the usual scoring points.
	b	i	as wind speed increases the noise increases / ora (1)	1	Examiner's Comments The majority of candidates described the main trend in the graph correctly.

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Question			Answer/Indicative content	Marks	Guidance
		ii	idea of: for **low** speeds / up to 5 m/s / up to mean speed - the noise level is below background / 33dB (1) idea of: for **high** speeds / above 5 m/s / above mean speed - the noise level is generally below / not much above background (1)	2	**allow** 'most dots below background (1) **eg.** 'turbine noise less than tree noise' (1) **eg** 'at high wind speeds the noise is rarely above background' (1) **allow** (if no other marks obtained) normal background is usually higher than turbine noise (1) **Examiner's Comments** Most gained a mark here but many candidates did not differentiate between low and high wind speeds thereby avoiding the opportunity of a second mark.
			Total	**5**	
32	a		0.34 or 34% (2) **but if answer incorrect** 170 000 (MJ) / 500 000 (MJ) (×100) (1)	2	0.34% (1) 34 (1) **Examiner's Comments** Candidates, in general correctly calculated the efficiency of the power station.
	b	i	direct (current) (1)	1	**allow** dc (1)
		ii	idea that readings change each side of the 0 / idea that readings are positive and negative or flow in two directions (during a cycle) / AW (1)	1	**allow** all change (in) direction (1) **allow** change from + to ? **Examiner's Comments** About half the candidates knew that a battery produces direct current (DC was also an acceptable answer). Few candidates were able to explain why all four graphs showed alternating current. Examiners were looking for an indication that the readings change from one side of the 0 line to the other or that the current kept changing direction.
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
33	a		any two from: idea of renewable energy (1) idea of no polluting waste produced (1) crops can be grown under them / placed at sea (1) useful in remote locations (1) (idea that) new technology are making wind turbines more efficient (than conventional power stations) (1)	2	**allow** does not need **fossil** fuels / named fossil fuel (1) **allow** no carbon dioxide produced / no greenhouse gases (1) **allow** idea of less global warming (1) **allow** idea of less maintenance / labour or staff required (1) **allow** generation close to consumer / AW (1) **ignore** pollution unless qualified Examiner's Comments The majority of candidates were able to describe the advantages of wind turbines over coal fired power stations. Whilst examiners credited advantages of wind generators it was good to see several true comparisons such as 'wind is renewable but coal will eventually run out'.
	b	i	as wind speed increases the noise increases / ora (1)	1	Examiner's Comments Very few candidates failed to score on this question and most gave the straight forward relationship 'the faster the wind the louder the noise'.

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Question			Answer/Indicative content	Marks	Guidance
		ii	idea of: For **low** speeds / up to 5 m/s / up to mean speed – the noise level is below background / 33dB (1) idea of: for high speeds / above 5 m/s / above mean speed – the noise level is generally below / not much above background (1)	2	**allow** 'most dots below background (1) **eg.** 'turbine noise less than tree noise' (1) **eg** 'at high wind speeds is the noise above background' (1) **allow** (if no other mark awarded) normal background is usually higher than turbine noise **Examiner's Comments** Candidates tended to score 1 mark for the general statement that the background noise is more noisy than the turbines for most of the time. In order to score the second mark some statement about when it was above background noise was needed, for example 'even at high wind speeds the noise of the turbines is not much more than background'.
			Total	**5**	

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Question			Answer/Indicative content	Marks	Guidance
34	a		any value in range 0. 10 - 0.12 (1)	1	if answer line is blank **allow** correct answer in table **Examiner's Comments** Candidates were able to see the pattern in the increase in current and predict an answer in the allowed range.
	b		(larger angle) more current / AW / ORA (1)	1	**ignore** stronger current **Examiner's Comments** Around half of the entry then went on to summarise the increase of current with angle of the light beam correctly. Poorer answers were centred on the idea of more light on the photocell (with increasing angle), without relating this to the current.
	c		5 × 0.22 = 1.10 (1)	1	**allow** first answer × 5 / answer in table (for 90°) × 5 **Examiner's Comments** Many logically explained answers using 5 times the current values for one photocell were given by candidates. Answers that only mentioned larger area so more light (falling) on 5 photocells failed to score.
	d		angle photocell to face the Sun / track position of Sun (1)	1	**allow** follow the Sun / always face the Sun / tilt towards the Sun / moves towards the light **allow** idea of photocell always facing south **Examiner's Comments** The idea of facing or tracking the Sun was not greatly appreciated; putting it 'in' or at 90° to the Sun were recurring answers that did not quite answer the question
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
35			**Level 3 (5–6 marks)** Answers must refer correctly to one explanation of the comparative power / energy losses **related to currents** in each circuit. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** Answers refer in part to the **relative power / energy losses OR changes in current in each circuit**. Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** Answers are limited to correct **references to voltage OR** show an appreciation of how the experiment **models real situations**. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted at grades up to A*** Indicative scientific points may include: **Level 3** • less power loss in B due to reduced current and heating effect • power loss is proportional to current^2 **Level 2** Answers show that • less power / energy is wasted at higher voltages / ORA • TA decreases current and TB increases current **Level 1** • TA is step-up and TB is a step-down transformer • TA increases voltage and TB reduces voltage • Simple idea of **less** energy loss linked to brighter lamp in transformer circuit • resistance wires represent transmission lines in National Grid **Use the L1, L2, L3 annotations in Scoris. Do not use ticks.** **Examiner's Comments** This was a 6 mark level of response question about transformers and the National Grid targeted up to A* grade. It was deliberately challenging, although good attempts were made by most candidates, with few non-attempts. High level answers (5 or 6 marks) were for answers that explained that the transformers reduced the current, temperatures and heat loss in the wires, thus reducing energy losses. Level 2 answers (3 or 4 marks) related to the

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Question			Answer/Indicative content	Marks	Guidance
					voltages needing to be high to reduce energy loss. Level 1 answers (1 or 2 marks) generally described the transformers as step-up and step down. 40% of candidates failed to score and generally only grade A* candidates successfully navigated the Level 3 physics required here. The question differentiated very well.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
36		i	24 +/- 4 scores (2) But if answer is incorrect or incomplete: correct plotting of both points (1)	2	tolerance for points is +/- ½ a square **Examiner's Comments** The first part was about using a graph plot to estimate the current at 30cm. Most candidates gained [2] here for 24cm (20-28cm). Those failing to fall into this range of +/-4 gained [1] for the correct plotting of the points.
		ii	as distance increases current falls scores / AW / ORA (1) **BUT** current falls quickly at start but less quickly for greater distances / AW (2) **OR** as distance doubles current is quartered (2)	2	**ignore** stronger or weaker current **allow** inverse square law (2) **Examiner's Comments** Most candidates could describe the basic trend [1], e.g. current reduces as distance increases [1]. Some were vague in describing current as weak or strong, slow or fast [0]. Better answers (less than 10%) went on to explain that as distance doubled the output quartered [2].
		iii	light diverges / spreads / becomes less intense / AW / ORA(1) **or** light intensity follows an inverse square law / AW (1)	1	(when closer) more energy / photons / light hits solar cell / AW / ORA (1) **Examiner's Comments** Most candidates could explain the trend here.
			Total	**5**	

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Question			Answer/Indicative content	Marks	Guidance
37	a		**Risk max 1** radiation **leak / leak** of nuclear material / **leak** of nuclear waste [1] power station / reactor may get damaged / attacked by terrorist / earthquake [1] radiation sickness / poisoning (1) **how the risk is reduced / managed max 1** monitor people (for contamination) [1] monitor radiation around the nuclear power station [1] safe storage or disposal of nuclear materials [1] idea of better control of reactor [1] better shielding against radiation loss [1] have good shut down / emergency procedures [1] extra protection if in earthquake risk area [1] better security at nuclear power station [1]	2	**ignore** power stations emit radiation **allow** correct examples such as radioactive materials stored (deep) underground / encased in (thick) concrete / lead (1) **allow** correct examples such as surround the reactor with (thick) concrete walls (1) **Examiner's Comments** This HSW question focussed on the risks of nuclear power generation and how to reduce these risks. Most candidates mistakenly thought that nuclear power stations continuously emit dangerous levels of radiation. Better answers described ‘leaks’ or ‘reactor problems’ that allowed radiation to escape’ [1]. Management of this risk such as creating a no-go area in such an emergency gained [1]. Nuclear waste being buried in glass deep underground was also a common answer [1].

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Question			Answer/Indicative content	Marks	Guidance
	b		Idea of voltage change [1] but voltage increase / steps up voltage [2] reduces energy loss / reduce the cost [1]	3	**allow** higher level answers e.g. idea of current change (1) **BUT** to reduce current [2] **allow** voltage reduces (1) **allow** reduces power loss **allow** increases efficiency (1) **ignore** stops energy loss **Examiner's Comments** About a fifth knew that (these) transformers changed the voltage [1]. Rather fewer went on to say they increased or stepped-up voltage [2] and that this was more efficient [1].
			Total	5	
38			reduces energy or power waste / heating (in cables) or increases efficiency (1) reduces costs (1) (enables) use of thinner wires (1) reduced current (due to increased voltage) (1)	2	Ignore references to ‘electricity’ or voltage. Eg. gets more electricity to houses (0) Eg. Less voltage lost (0) No absolutes accepted: Eg. **NOT** stops energy waste (completely) Eg. **NOT** wires don’t get hot **BUT** wires do not get **as** hot scores (1) **Allow** more power / energy to the consumer / AW (1)
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
39	a		earth – safety wire / stops appliance becoming live / prevents shock(1) live – brown (1) neutral – blue (1)	3	
	b		live (and) neutral (1)	1	both required, either order
			Total	4	
40		i	25 000 (V) 275 000 (V) 230 (V)	1	all three correct = 1 mark
		ii	step-up used (to increase voltage) at power station or before National Grid (1) step-down used (to decrease voltage) after National Grid or at houses (1)	2	if no other marks awarded **allow** there are step-up **and** step-down transformers to change the voltage (1)
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
41			EARTH - safety wire / stops appliance becoming live / to allow (large) current or flow of charge to go to Earth / ground (if live touches metal case) (1) --- LIVE - contains fuse or provides (high) voltage / current / energy / power (1) --- NEUTRAL - completes the circuit (1)	3	Reference to shock must be qualified Eg. protects user from shock / can't get a shock ignore reference to fuse for this marking point not merely connects to earth / connects to the ground --- allow 'carries voltage' / 230 to 240V (1) ignore just 'supplies or carries electricity' allow idea of electron flow / charge flow (1) --- allow 'is at zero volts' (1) allow carries current or charges flow (1) allow neutral wire is earthed at the power station (1)
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
42	a		AC DC DC	2	all 3 correct = 2 marks 1 or 2 correct = 1 mark
	b		**maximum two from:** you need a sources of energy / fuel burned (1) steam produced (1) to cause a generator to turn / turbine spins (1) **maximum two from:** (electricity) passes through a (step-up) transformer (1) through a network of power lines / National Grid (1) it passes through a (step-down) transformer (1) **low voltage** supplied to consumers (1)	3	**Allow** boils water
			Total	**5**	
43			Harry (no mark) **Any one from:** deforestation reduces the number of trees (1) less carbon dioxide absorbed / removed from the atmosphere / less photosynthesis AW (1)	1	**allow** answer without mention of Harry if deforestation reason correct
			Total	**1**	
44			**A ✓**	**1 (AO1.1)**	
			Total	**1**	

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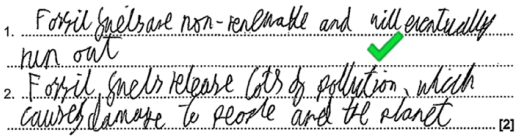
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Question			Answer/Indicative content	Marks	Guidance
45	a	i	5.2 (billion tonnes oil equivalent) ✓	1 (AO3.1a)	ALLOW answers between 5.0 and 5.5 IGNORE wrong units
		ii	Oil ✓	1 (AO3.1a)	Examiner's Comments Part (a)(i) and (ii) assessed AO3 and required 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.

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Question			Answer/Indicative content	Marks	Guidance
	b	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 (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 / carbon emissions IGNORE just pollution or bad for the environment / more CFCs <u>Examiner's Comments</u> 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.

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Question			Answer/Indicative content	Marks	Guidance
		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 <u>Examiner's Comments</u> 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.
	c	i	Step-up transformer ✓	**1** (AO1.1)	<u>Examiner's Comments</u> 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.

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Question			Answer/Indicative content	Marks	Guidance
		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

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Question			Answer/Indicative content	Marks	Guidance
		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'.
	d	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 = current^2 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

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Question			Answer/Indicative content	Marks	Guidance
					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'.
			Total	18	

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Question			Answer/Indicative content	Marks	Guidance
46	a	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.

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Question			Answer/Indicative content	Marks	Guidance
	b	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.

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Question			Answer/Indicative content	Marks	Guidance
	c	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.

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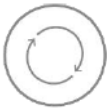
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Question			Answer/Indicative content	Marks	Guidance
	d	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2.8 (kW) award 4 marks	4	ALLOW 2.78 kW or 2.783 kW ✓✓✓✓
			(P =) $I^2 \times R$ ✓	(AO 1.2)	ALLOW equation in any form
			11 × 11 × 23 or 112 × 23 or 121 × 23 ✓	(AO 2.1)	
			= 2783 ✓	(AO 2.1)	
			Conversion to kW = 2.8 (kW) ✓	(AO 2.1)	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'.

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Question			Answer/Indicative content	Marks	Guidance
		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.
			Total	18	
47			A ✓	1 (AO 1.1)	
			Total	1	
48			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	

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Question			Answer/Indicative content	Marks	Guidance
49			**Advantage - Any one from:** no carbon dioxide produced / does not contribute to global warming/climate change/acid rain / no polluting gases ✓ 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 ✓	2 (AO 2×1.1)	**ALLOW** a named polluting gas **IGNORE** (idea of) ozone layer **ALLOW** (idea of) risk from terrorists **ALLOW** (idea of) explosion **IGNORE** just dangerous <u>Examiner's Comments</u> 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	

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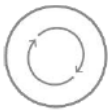
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Question			Answer/Indicative content	Marks	Guidance
50	a		A.C. (transmitted in power lines) / (electrical/electron/particle) oscillations / AW ✓ **BUT** Alternating currents/(electrical/electron/particle) oscillations produce (radio) waves/electromagnetic radiation ✓✓	2 (AO2×1.1)	<u>Examiner's Comments</u> 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.

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Question			Answer/Indicative content	Marks	Guidance
	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 <u>Examiner's Comments</u> 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.

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Question			Answer/Indicative content	Marks	Guidance
	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 ✓✓✓✓ <u>Examiner's Comments</u> 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	
51			**C** ✓	1 (AO1.1)	<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.
			Total	1	

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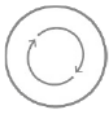
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Question			Answer/Indicative content	Marks	Guidance
52			B ✓	1 (AO1.1)	Examiner's Comments Candidates found this question very challenging. It tested whether candidates understood that direct current was a flow in one direction. A large number of candidates incorrectly gave response C presumably since they thought that this demonstrated a constant potential difference. The correct response shows a varying direct current.
			Total	1	
53			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	

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Question			Answer/Indicative content	Marks	Guidance
54			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 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.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
55			Any one from: supplies of uranium are large enough / will not run out to consider it renewable / AW ✓ Uranium is not being replaced / used quicker than it is being replaced to consider it non-renewable	1 (AO 2.1)	Examiner's Comments Many candidates incorrectly referred to fusion rather than fission. Candidates are advised to underline key 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	
56			D ✓	1 (AO2.2)	
			Total	1	
57			A ✓	1 (AO1.1)	
			Total	1	
58		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	
59			B ✓	1 (AO2.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
60		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	

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Question			Answer/Indicative content	Marks	Guidance
61			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** 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	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 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

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Question			Answer/Indicative content	Marks	Guidance
			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.		• 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**	
62			**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**	

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