1. A National Grid transformer in a sub-station converts 30 000 V into 230 V to power a town of 12 000 inhabitants. The transformer is 99% efficient.

Using appropriate estimates, discuss the energy consequences **for the transformer sub-station** if the efficiency is less than 100%.

---

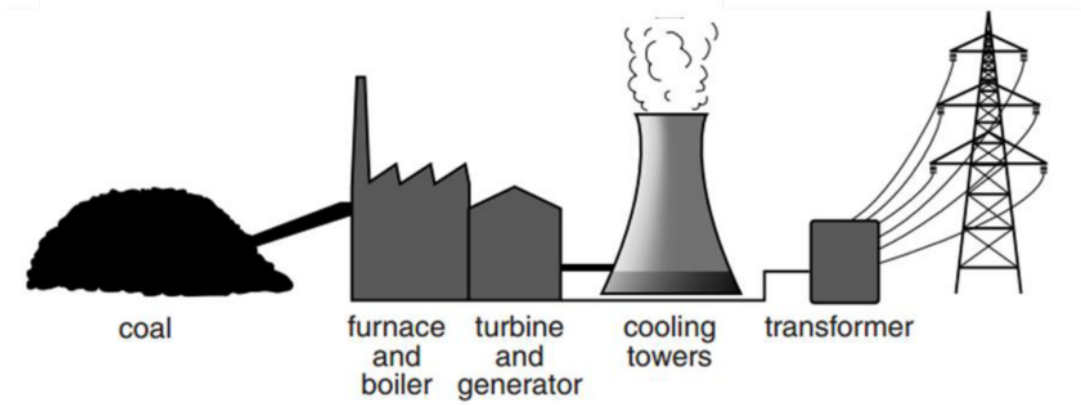
---

---

---

[2]

2(a). In a coal burning power station large amounts of heat energy are needed to convert water to steam.




(i) Name an energy resource which does **not** need a furnace or boiler, as it can drive the turbine directly when generating electricity.

---------- [1]

(ii) Write down **one** advantage and **one** disadvantage this method of generating electricity has over a coal burning power station.

---

---

---

---------- [2]

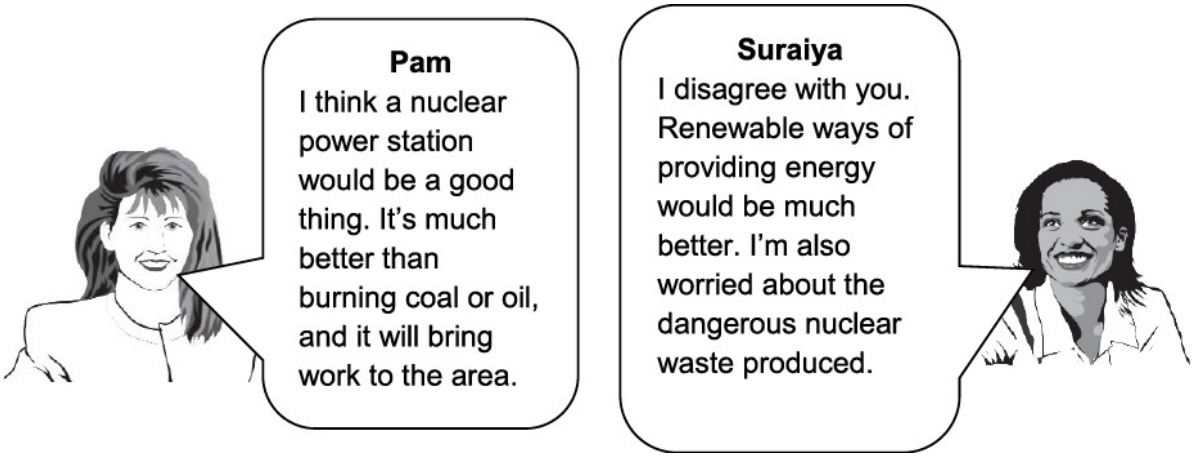
(b). Some coal-burning power stations can provide some of their waste energy to heat local houses and industries. However, the efficiency of these Combined Heat and Power stations is reduced from a typical coal-burning power station.

Select **one** answer below to give a location where this would be useful.

| | |
|---|---|
| Town A: small population far from power station | |
| Town B: large population close to power station | |
| Town C: large population far from power station | |
| Town D: small population close to power station | |

[1]

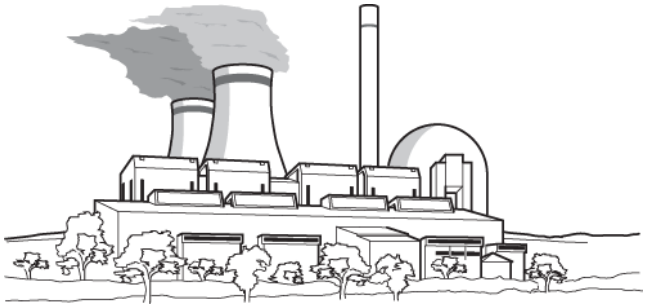
3. Two people are discussing plans to build a nuclear power station near their town.




Explain the different points of view put forward by these two people, and state, with reasons, which of the two has the better argument.

[6]

4. Over the next 50 years, it is predicted that the worldwide demand for electricity will increase greatly, particularly in developing countries where the population is increasing and more people are moving into cities.



Discuss the implications of these predictions in terms of the sustainability of primary energy sources and the environmental effects of their use.

*The quality of written communication will be assessed in your answer.*.

[6]

5(a). The table below shows data about three different power stations.

| Power station | Primary fuel | Efficiency (%) | Output voltage (kV) | Output power (MW) |
|---|---|---|---|---|
| A | coal | 33 | 24 | 1400 |
| B | gas | 42 | 28 | 1100 |
| C | uranium | 33 | 22 | 1200 |

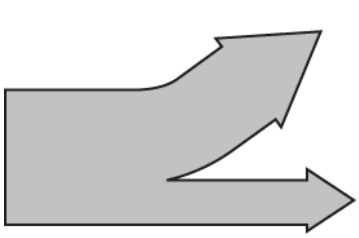
For each statement below, put a tick (?) in the **one** correct box.

| | Power station A | Power station B | Power station C |
|---|---|---|---|
| The power station produces the least carbon dioxide. | ☐ | ☐ | ☐ |
| The generator produces the largest current. | ☐ | ☐ | ☐ |
| The energy produced each second from the primary fuel is smallest. | ☐ | ☐ | ☐ |

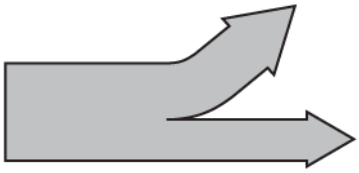
**[2]**

(b). The three Sankey diagrams below describe these three power stations. The three diagrams are drawn to the same scale.

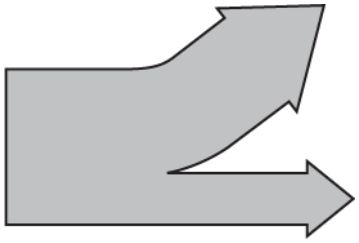
In the space under each diagram, write the letter (**A**, **B** or **C**) for that power station.



.....



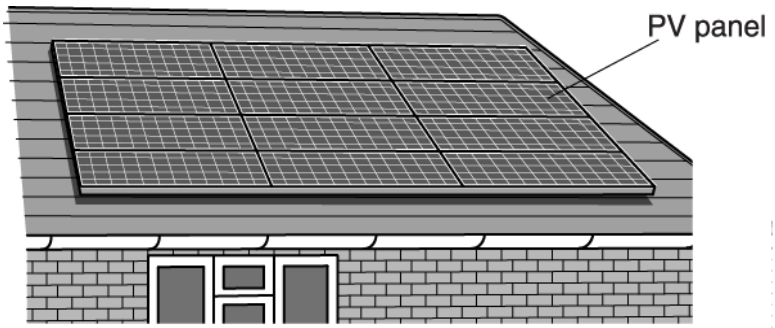
.....



.....

**[2]**

6. Many house-owners are putting sets of photovoltaic (PV) panels on their roofs to generate electricity during daylight. The panels work best if the roof used is facing south.




The data about the type of PV panel shown in the diagram are given in the table.

| | |
|---|---|
| size of one panel (m × m) | 1.5 × 0.8 |
| average daily energy output of one panel (kWh) | 0.6 |
| cost per panel | £200 |

A family needs about 24 kWh of electricity per day, averaged out over the winter and the summer.

This family has decided to fit 12 panels on their roof to provide their energy needs throughout the year.

Discuss the advantages and disadvantages of fitting these panels to their roof.

*The quality of written communication will be assessed in your answer.*

[6]

7. The boxes below give types of energy sources used by power stations together with some of their disadvantages.

For each **energy source**, put a tick (✓) in **each** box describing its **disadvantages**.

| Energy source | Possible disadvantage | | |
|---|---|---|---|
| | generates greenhouse gases when working | power station needs to pay for fuel | cannot be used in all countries |
| biofuel | | | |
| coal | | | |
| hydroelectricity | | | |

**[2]**

8. Many people object to the pollution produced by the UK's gas and coal power stations. The current nuclear reactors are coming to the end of their working lives.

What factors should a government take into account when planning a future energy policy?

*The quality of written communication will be assessed in your answer.*

[6]

9. Not all energy sources need a furnace or boiler.

Which energy sources drive the turbine directly when generating electricity?

Put a tick (✓) in the box next to each correct answer.

biofuel ☐

nuclear ☐

oil ☐

solar ☐

wind ☐

wave ☐

**[1]**

10. About a third of the UK's electricity is produced by burning coal. Two other major sources of energy for producing electricity are the use of nuclear power and burning gas.

For every MWh of electricity generated by burning coal, 0.4 grams of radioactive materials are produced. Much of this waste is present in the flue gases as ‘fly ash’.

For every MWh of electricity generated in a nuclear power station, 0.04 grams of radioactive waste are produced. This waste is contained in the ‘spent’ fuel rods.

The radioactive waste from nuclear power stations is more hazardous than the ash from the coal-burning power stations.

Discuss the different problems associated with the waste produced in coal-burning and nuclear power stations.

---

---

---

---

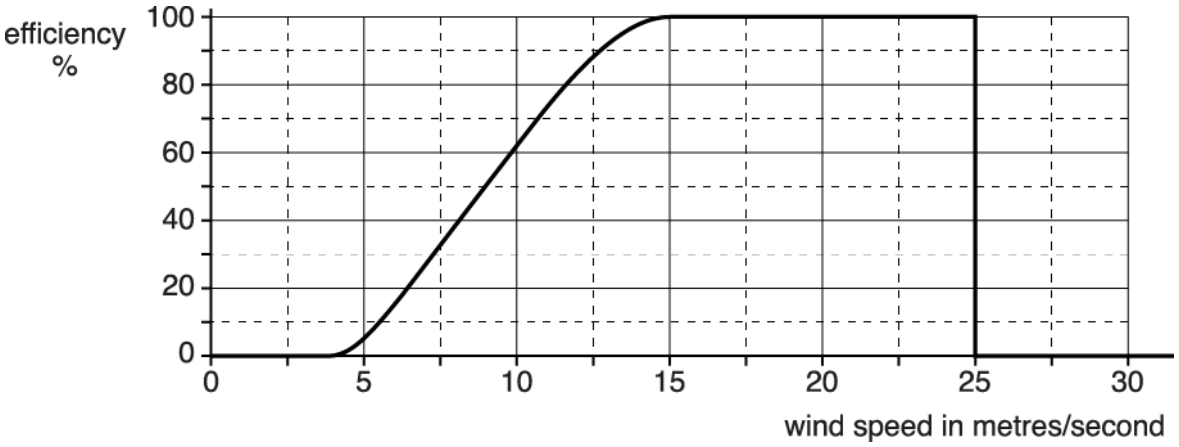
---

---

**[3]**

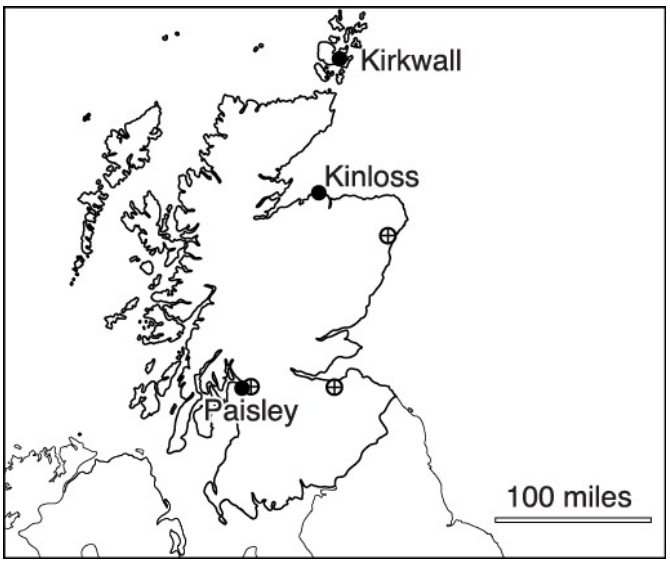
11. Wind turbines are used in wind farms in the UK to generate electricity.

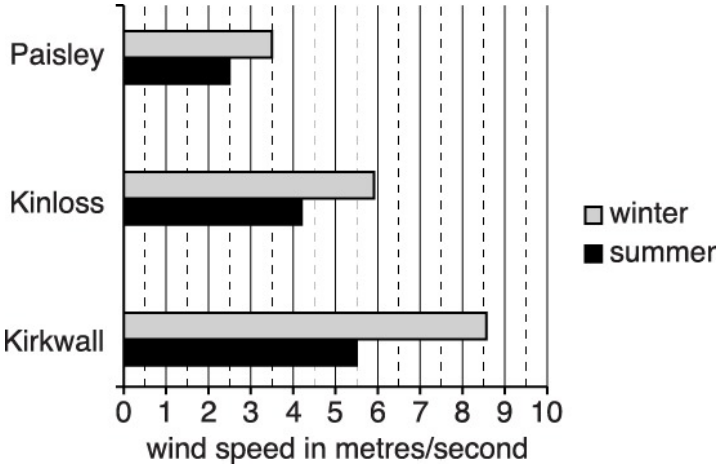
As the following graph shows, the efficiency of a wind turbine depends on the wind speed.




Three locations in Scotland have been studied as possible sites for large wind farms. These places, Paisley, Kinloss and Kirkwall, have been marked (•) on the map of Scotland.

The wind speed for these three places is shown in the bar chart. It shows average wind speed during winter and summer for the three possible wind farm sites.






Another factor to consider is the distance from the wind farm site to the consumers.

Half of all consumers in Scotland live in or near the three largest Scottish cities (marked ⊕ on the map of Scotland).

Use the data to compare the three sites for suitability as locations for a large wind farm.

*The quality of written communication will be assessed in your answer.*

[6]

12. A generator is an important part of any power station.

The block diagram below shows the different parts of a hydroelectric power station.

Complete the diagram by naming parts **A**, **B** and **C**.


**[2]**

13. New providers of electricity are attempting to gain customers who are concerned about the environment.

Here is the advertisement for one provider:

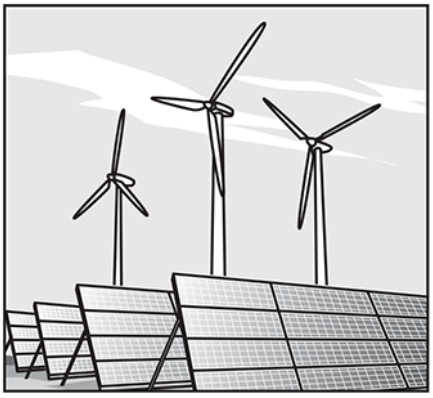
**OCR Green Energy – the way forward**

Change to our company, and we can guarantee that all your electricity will come from renewable sources – wind, solar, water and biofuel.

Do your bit to combat global warming!

And that's not all – we're cheaper than the big energy suppliers, too!

For more information, see our website www.OCRGreen.com



A householder is thinking about changing to this energy provider.

Discuss the advantages and disadvantages, for the householder and for the country as a whole, of making this change.

*The quality of written communication will be assessed in your answer.*

[6]

[Total: 6]

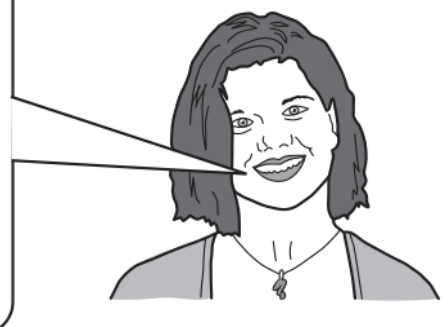
14. A large solar farm in England has a total area of 216 000 $m^2$ covered by PV panels.
Every square metre of the solar panels receives about 1000 W of power from the Sun during each day.

The panels have an efficiency of energy transfer of 15%.

* Many people are not in favour of solar farms.

**Jane**
Solar farms are ugly and take up such a lot of space. Their output power is very small. A gas-burning power station can provide 1000 MW all day and night, the whole year long, and in any weather.

I'm told that extracting and purifying the material for the PV panels is very polluting, so it's not as green as people say.



Discuss what Jane has said about solar farms and gas-burning power stations.

---

---

---

---

---

---

---

---

---

[6]

END OF QUESTION PAPER

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 1 | | | Energy dissipated in transformer will result in heat up of substation. If not removed it will result in a meltdown. (1)<br><br>Large amount of energy justified by estimate e.g. 1 to 5kW per person. Typical output current at 230V of 200 – 10 000 A (1) | 2 | |
| | | | **Total** | **2** | |
| 2 | a | i | Wind / tidal / wave / HEP | 1 | **do not allow** 'solar' |
| | | ii | Any suitable advantage relating to d(i) – renewable / sustainable / no greenhouse gases during power generation / no emissions that cause acid rain. (1)<br><br>Any suitable disadvantage (1)<br>e.g. damage to habitats | 2 | **do not allow** 'cleaner' |
| | b | | Town D | 1 | |
| | | | **Total** | **4** | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 3 | | | *Please refer to point 10 of the marking instructions of this mark scheme for guidance on how to mark this question.*<br><br>**(Level 3)**<br><br>Balanced explanation of both points of view linked to the risks / benefits.<br>**AND**<br>Judgement made as to the better argument.<br><br>*There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*<br><br>(5–6 marks)<br><br>**(Level 2)**<br><br>Explains at least one point in favour of nuclear power and one against.<br>**AND**<br>Makes a reasoned choice of Pam or Suraiya as being right.<br><br>*There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*<br><br>(3–4 marks)<br><br>**(Level 1)**<br><br>States differences between renewable and non-renewable energy sources.<br>**AND**<br>Considers only one side of the argument.<br><br>*The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.*<br><br>(1–2 marks) | 6 | **AO1.1 Renewable vs. Non-renewable energy resources**<br>**For example:**<br><br>• coal and oil are non – renewable so will run out<br>• nuclear is also non renewable<br>• a renewable energy resource will not run out e.g. wind, wave, solar etc.<br><br>**AO1.1 Nuclear energy hazards**<br>**For example:**<br>ionising radiation can have hazardous effects, notably on many varied types of living organisms and plants.<br><br>**AO2.2 Compare the ways in which the main energy resources are used to generate electricity**<br><br>**AO 3.1b Risk / benefit**<br><br>• $CO_2$ contributes to global warming<br>• nuclear waste could leak / enter the biosphere<br>• risk small, but consequence serious<br>• possibility of employment in new power station<br>• which may bring money into the area<br>• nuclear power stations don't produce $CO_2$ (once built)<br>• coal / gas produce $CO_2$<br>• solar / wind / hydroelectric / tidal don't produce $CO_2$ at the point of electricity generation<br>• radioactive waste produced in nuclear power stations.<br><br>**AO3.2b**<br>**Judgement made as to the better argument** |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | | No response or no response worthy of credit.<br><br>(0 marks) | | |
| | | | Total | 6 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 4 | | | **(Level 3)**<br>Discussion of both sustainability and environmental effects. The answer should also address the consequences of population change marked (P) in the guidance column. Quality of written communication does not impede communication of the science at this level.<br>(5 – 6 marks)<br><br>**(Level 2)**<br>Both sustainability and environmental effects discussed or a discussion of one area with treatment of population (P) issues. Quality of written communication partly impedes communication of the science at this level.<br>(3 – 4 marks)<br><br>**(Level 1)**<br>Either sustainability or environmental effects discussed. Quality of written communication impedes communication of the science at this level.<br>(1 – 2 marks)<br><br>**(Level 0)**<br>Insufficient or irrelevant science. Answer not worthy of credit.<br>(0 marks) | | This question is targeted at grades up to A*<br><br>Indicative scientific points related to sustainability may include:<br><br>• more fossil fuels (and uranium) are used<br>• primary fuels are running out<br>• fuel may need transporting large distances<br>• alternative energy sources cannot supply enough energy<br>• alternative energy sources reduce demand from conventional power stations<br>• (P) increased population ? **greater rate** of depletion / use of resources<br>• (P) more power stations needed<br>• (P) the pattern of distribution of energy within countries will change<br>• (P) population movement will change energy demand in cities<br><br>Indicative scientific points related to environmental effects may include:<br><br>• fossil fuels produce $CO_2$ / greenhouse gas<br>• consequences of resulting climate change/global warming<br>• nuclear power station produce radioactive waste<br>• wind farms/solar farms/biofuel plants are often considered unsightly or displace other land use<br>• (P) (greatly) increased energy use will **accelerate** climate change / global warming<br>• (P) movement to cities will involve greater transportation of primary fuels / electrical distribution<br><br>Use the L1, L2, L3 annotations in Assessor; do not use ticks.<br><br>Examiner's Comments<br><br>This extended response 6-mark question was well answered by most, but level 3 |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | | | | responses require use of all the information given: not only the ideas of sustainability and environmental impact of different power stations (which was very well tackled by almost all candidates) but also the fact that developing countries have increasing populations with increasing urbanisation which was in the stem of the question. |
| | | | Total | 6 | |
| 5 | a | | C, A, B | 2 | all correct = 2, two correct = 1 |
| | b | | C, B, A | 2 | all correct = 2, one correct = 1 unless same answer given to all which =0<br>may write words, i.e. Uranium Gas Coal<br><br>Examiner's Comments<br><br>This was an objective question testing the ability to read and manipulate the data in the given table in part **(a)** and to identify the appropriate Sankey diagrams in part **(b)**; accordingly, part **(b)** was the more straight-forward and was completely correctly answered by about half of all candidates. |
| | | | Total | 4 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 6 | | | **(Level 3)**<br>Uses a correct, relevant calculation(s) and discusses both advantages and disadvantages.<br><br>Quality of written communication does not impede communication of the science at this level.<br>(5–6 marks)<br><br>**(Level 2)** May quote data without calculation. Attempts a balanced argument of advantages and disadvantages OR an unbalanced argument supported by calculation.<br><br>Quality of written communication partly impedes communication of the science at this level.<br>(3–4 marks)<br><br>**(Level 1)**<br>Qualitative discussion of one side of the argument only.<br>May not attempt a balanced argument.<br><br>Quality of written communication impedes communication of the science at this level.<br>(1–2 marks)<br><br>**(Level 0)**<br>Insufficient or irrelevant science. Answer not worthy of credit.<br>(0 marks) | 6 | This question is targeted at grades up to C<br>Indicative scientific points may include:<br>Ignore confusion between PV and solar heating panels.<br>Advantages<br><br>• No $CO_2$ / no pollution produced / won't harm environment / eco-friendly<br>• Renewable / will not run out<br>• Power cuts won't affect them<br>• Reduces the household bill<br>• Can get money for excess electricity<br>• The electricity produced is free<br><br>Disadvantages<br><br>• Doesn't produce all of the electricity required / less electricity in winter when needed most<br>• Needs lots of panels / not enough panels for whole bill<br>• Initial cost / outlay of money / takes time to pay back<br>• Variable output with light / clouds / winter / night<br>• Other sources of energy needed<br>• Heavy / damaging on roof<br>• Ugly<br>• Maintenance needed<br><br>Data calculations<br><br>• 40 panels required to provide all the electricity<br>• 12 panels would produce 12 X 0.6 = 7.2 kWh not 24kWh / Energy bill is reduced by a third<br>• Total area of 12 panels is = 12 × 1.5 × 0.8 = 14.4 $m^2$<br>• The cost of 12 panels is 12 × £200 = £2400.<br><br>Use the L1, L2, L3 annotations in Scoris; do not use ticks.<br><br>Examiner's Comments<br><br>This extended response 6-mark question was generally well done, with many |

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>candidates able to discuss pros and cons of installing the panels in both environmental and cost terms, supporting their answer by relevant calculations using the data provided.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>6</td><td></td></tr>
<tr><td>7</td><td></td><td></td><td>
<table>
<tr><th rowspan="2">Energy source</th><th colspan="3">Possible disadvantages</th></tr>
<tr><th>Generates $CO_2$</th><th>Power station needs to pay for fuel</th><th>Cannot be used in all countries</th></tr>
<tr><td>Biofuel</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Coal</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Hydro</td><td></td><td></td><td>✓</td></tr>
</table>
</td><td>2</td><td>mark by rows<br>all correct = 2<br>one or two correct rows = 1<br><br>Examiner's Comments<br><br>Both objective parts proved difficult, with those scoring 1 mark generally knowing that the disadvantage of hydroelectricity is that it cannot be used in all countries. Many candidates did not realise that power stations need to pay for biofuel and there was evidence that some candidates were looking to give only 1 tick on each row, which perhaps suggests that they had not read or understood the question clearly enough and so were guessing.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>2</td><td></td></tr>
</table>

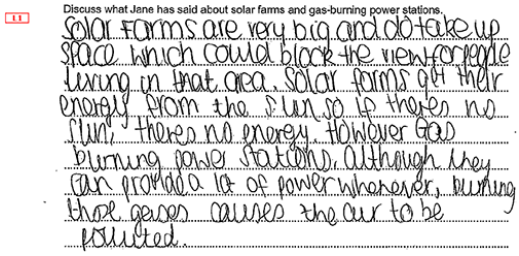
| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 8 | | | [Level 3]<br>Considers a wide range of factors [at least 4] with 2 examples.<br>**Must include** an idea of comparing / balancing these factors.<br>Quality of written communication does not impede communication of the science at this level.<br><br>(5–6 marks)<br><br>[Level 2]<br>List some factors [at least 3], include an example or gives context.<br>Quality of written communication partly impedes communication of the science at this level.<br><br>(3–4 marks)<br><br>[Level 1]<br>Lists simple factors [at least 3], little or no context.<br>Quality of written communication impedes communication of the science at this level.<br><br>(1–2 marks)<br><br>[Level 0]<br>Insufficient or irrelevant science. Answer not worthy of credit.<br><br>(0 marks) | 6 | This question is targeted at grades up to A*<br><br>Relevant points include:<br><br>Indicative of L3<br><br>• ever increasing demand<br>• long term economics / budgeting / decommissioning<br>• managing waste / balance of costs<br>• role of government in setting regulations<br>• need for a mix of sources.<br><br>Indicative of L2<br><br>• alternatives to building new supplies e.g., reducing demand<br>• building costs<br>• waste defined<br>• role of government in setting policy<br>• to ensure security of supply<br>• carbon dioxide emissions.<br><br>Indicative of L1<br><br>• environmental impact<br>• cost<br>• waste unqualified<br>• pollution unqualified<br>• use renewable resources.<br><br>**do not accept** government building power station / supplies.<br><br>Use the L1, L2, L3 annotations in Scoris; do not use ticks.<br><br>Examiner's Comments<br><br>The majority gave a list of factors (most commonly ‘pollution’ ‘sustainability’ and ‘cost’), usually correct. Many went on to provide examples or context (Carbon dioxide emissions and global warming were common). Very few candidates provided an idea of comparing or balancing factors. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | | Total | 6 | |
| 9 | | | Biofuel: ; Nuclear: ; Oil: ; Solar: ; Wind: ✓ ; Wave: ✓ | 1 | requires both ticks for one mark<br><br>Examiner's Comments<br><br>Many candidates only ticked one of the correct boxes and so gained 0 marks or added an extra tick in 'solar'. |
| | | | Total | 1 | |
| 10 | | | **generic hazards:**<br>ionising radiation emitted by radioactive materials (1)<br>and can cause cellular damage / mutation / cancer (1)<br>**coal-burning power station:**<br>emits (lots of) $CO_2$ (a major greenhouse gas) (1)<br>emits lots of / nearly 10 × as much radioactive waste (as nuclear power station) (1)<br>fly ash can be breathed causing radioactive contamination (1)<br>fly ash would be spread into environment (by wind) (1)<br>filters / screens are used to remove nearly all fly ash (1)<br>**nuclear power station:**<br>idea of controlled disposal needed for nuclear waste (1)<br>nuclear waste is more concentrated / long lasting than fly ash (credit correct P6 discussion here) (1) | 3 | any three points.<br><br>ORA: nuclear doesn't emit $CO_2$<br>ORA: nuclear produces less radioactive waste<br><br>N.B. all Physics candidates will also have done Unit 6, but Science candidates will not, and so will not have studied the different sorts of radioactive waste. These can be credited but should not be required.<br><br>Examiner's Comments<br><br>This question was intended to allow candidates to compare the relative risks of radioactive waste in the fly-ash from coal-burning power stations and the nuclear waste from nuclear power stations. Marks here tended to be earned from the generic marks explaining why radioactive materials introduce risk, and also from the fact that coal-burning power stations produce carbon dioxide, a green house gas (this had to be allowed as a legitimate answer as the question asked for 'the different problems associated with the waste' not '…with the radioactive waste'). A surprisingly large number made no reference to the first sentence in the stem and stated 'coal-burning power stations do not produce radioactive waste.' |
| | | | Total | 3 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 11 | | | **(Level 3)**<br>Analyses each site in terms of advantages and disadvantages, with quantitative use of data from graph and bar chart. Quality of written communication does not impede communication of the science at this level.<br><br>(5–6 marks)<br><br>**(Level 2)**<br>Makes qualitative use of bar chart combined with efficiency graph to compare site feasibility with reference to distance from site to consumers. Quality of written communication partly impedes communication of the science at this level.<br><br>(3–4 marks)<br><br>**(Level 1)**<br>Makes simple comparison of wind speed differences or locations for all three sites. Quality of written communication impedes communication of the science at this level.<br><br>(1–2 marks)<br><br>**(Level 0)**<br>Insufficient or irrelevant science. Answer not worthy of credit.<br><br>(0 marks) | 6 | **This question is targeted at grades up to A***<br><br>**Indicative scientific points related to wind speed may include:**<br><br>• need speeds in range > 5 m/s to work<br>• bar chart shows averages, so can be 0 or can be very large<br>• winter speeds greater than summer<br>• winter energy requirements greater than summer<br>• Paisley has speeds too low to generate any electricity<br>• Kinloss just about OK<br>• Kirkwall the best provider.<br><br>**Indicative scientific points related to situation may include:**<br><br>• Paisley close to users<br>• Kinloss not too far from a city (Aberdeen)<br>• Kirkwall very distant<br>• Kirkwall not on mainland (so undersea cables needed)<br>• but infrastructure may be already in place<br>• maintenance is harder for more remote locations<br>• half of all Scots don't live in the three cities (and are presumably spread around Scotland).<br><br>At L1, candidate will probably not combine data; at L2 candidates will combine graph and bar chart but in a descriptive way; at L3, data are used quantitatively (combining wind speed & efficiency) to compare sites.<br><br>**Use the L1, L2, L3 annotations in Scoris; do not use ticks.**<br><br>Examiner's Comments<br><br>?This was the most demanding extended response 6-mark question on the paper, and over half the candidates restricted the marks available to a maximum of 2 by failing to make any reference to the |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | | | | efficiency graph. As the question stem provided a graph, a map and a bar chart, candidates should expect to have to extract information from all three.<br><br>The question stem stated that a factor to consider was the distance from the wind farm site to the consumers. Candidates read this in two different ways: that transporting energy over a greater distance involved greater energy losses, or that having a wind farm close to where many people live was unsightly and a source of noise pollution. Both arguments were acceptable. The best answers compared summer and winter performance at the different sites and deduced that a wind farm at Paisley would produce little if any power whereas Kirkwall would be the most productive, often choosing Kinloss as a compromise between efficiency and distance. |
| | | | Total | 6 | |
| 12 | | | turbine generator transformer<br>turbine followed immediately by generator (1)<br>generator followed immediately by transformer (1) | 2 | if turbine…… XXXX…… transformer, **allow** 1 mark<br><br>e.g. ‘pipe turbine generator’ gets m.p.1<br><br>Examiner's Comments<br><br>??Relatively few candidates labelled the boxes to name the parts of the system, instead they described the process. Provided that the candidates description involved a turbine, followed by a generator and then a transformer, even in the same box, credit was given. A large number did not read ‘hydroelectric power station’ and including a boiler, or a description of its function, in the system. |
| | | | Total | 2 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 13 | | | **(Level 3)**<br>Discusses advantages and disadvantages to householders and to the country as a whole using examples from all three areas. Quality of written communication does not impede communication of the science at this level.<br><br>(5–6 marks)<br><br>**(Level 2)**<br>Discusses advantages and disadvantages, using examples from more than one area. May restrict answer to householders or to the country as a whole but not consider both. Quality of written communication partly impedes communication of the science at this level.<br><br>(3–4 marks)<br><br>**(Level 1)**<br>Discusses advantages **or** disadvantages using examples from one area **OR** gives an advantage **and** a disadvantage, using examples from one area. May restrict answer to householders or to the country as a whole but not consider both. Quality of written communication impedes communication of the science at this level.<br><br>(1–2 marks)<br><br>**(Level 0)**<br>Insufficient or irrelevant science. Answer not worthy of credit.<br><br>(0 marks) | 6 | This question is targeted at grades up to C<br><br>Indicative scientific points may include:<br>Supply issues<br><br>• reliability<br>• capacity<br>• locating sufficient sites for installation<br>• displaced land use<br>• reduces the need to import energy from other countries<br><br>Environmental impact<br><br>• reduces use of fossil fuels<br>• less $CO_2$<br>• reduces global warming<br>• habitat loss<br>• identified pollution, e.g. health issues related to air quality, ugly solar farms, noisy wind farms<br>• no radioactive waste produced<br><br>Economic impact<br><br>• cheaper<br>• installation costs<br>• job loss / creation<br>• payback time<br>• need to be aware of lobbying by e.g. local groups, big oil companies<br>• renewables won't run out / sustainable<br><br>Use the L1, L2, L3 annotations in Scoris; do not use ticks. |
| | | | Total | 6 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 14 | | | *Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question.*<br><br>**Level 3 (5–6 marks)**<br>Detailed, balanced discussion of the advantages and disadvantages of solar farms and gas-burning power stations not restricted to statement as made by Jane. May query Jane's source for PV pollutions.<br>*There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*<br><br>**Level 2 (3–4 marks)**<br>Describes one advantage AND one disadvantage of BOTH solar farms and gas-burning power stations. Discusses points mentioned by Jane and with some evaluation.<br>OR<br>Describes more than one advantage /disadvantage of BOTH solar farms and gas-burning power stations.<br>*There is a basic line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.*<br><br>**Level 1 (1–2 marks)**<br>Largely quotes material from Jane's statement. Describes an advantage or disadvantage of BOTH solar farms and gas-burning power stations.<br>OR<br>Describes one advantage AND one disadvantage of one type of power station.<br><br>*There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*<br><br>**0 marks**<br>*No response or no response worthy of credit.* | (AO 2 x 1.1)<br>(AO 2.2)<br>(AO 3 x 3.2b)<br><br>6 | **AO1.1 Renewable vs. Non-renewable energy resources**<br>For example:<br><br>• Gas is non – renewable so will run out<br>• Solar is renewable<br>• A renewable energy resource will not run out<br><br>**AO2.2** Compare the ways in which the main energy resources are used to generate electricity<br><br>**AO3.2b Advantages and disadvantages**<br><br>• CO2 contributes to global warming<br>• solar power stations don't produce CO2 (once built)<br>• solar output is about 300 × smaller than gas [e.c.f part **(a)**]<br>• gas produces CO2<br>• solar doesn't produce CO2 at the point of electricity generation<br>• solar panel production is polluting<br>• solar farms take up farming/building land<br>• but some may be used, e.g. grazing sheep<br><br>Examiner's Comments<br><br>Most candidates demonstrated Level 2 performance in their responses to this question, often at the top of the band.<br><br>**Exemplar 18**<br><br>This Level 1 response largely restricts itself to paraphrasing Jane's speech bubble and was credited with two marks.<br><br>  <br>Discuss what Jane has said about solar farms and gas-burning power stations.<br>Solar farms are very big and do take up space which could block the view for people living in that area. Solar farms get their energy from the sun so if there's no sun, there's no energy. However Gas burning power stations, although they can provide lot of power whenever, burning those gases causes the air to be polluted. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | | | | **Exemplar 19**<br><br>This Level 2 response was credited with four marks and gives a more balanced comparison of the two types of power stations.<br><br>Jane is correct in that ~~a~~ gas-burning power stations are much more reliable than solar farms. Solar farms are only effective when there is sunshine which does not always occur. Gas-burning stations are able to provide more power because they don't not depend on a natural resource that is inconsistent in its occurance. However ~~gas-bur~~ a disadvantage of gas-burning stations is that the natural gas from fossil fuels, ~~are~~ is non-renewable. Therefore, one day it will run out as there is a finite amount and we will have to be able to use renewable sources such as solar panels efficiently before that happens [6]<br>L2<br><br>**Exemplar 20**<br><br>This Level 3 answer was credited with all six marks. The candidate has written a full and coherent evaluation of the merits and disadvantages of the two systems.<br><br>L3<br>Discuss what Jane has said about solar farms and gas-burning power stations.<br>Jane is incorrect because although power stations can produce more power, solar farms can still produce enough power, especially if more were installed. In addition, gas-burning power stations are extremely polluting, as they emit dangerous levels of greenhouse gases. By comparison, any pollution from solar panels would be insignificant. Furthermore, power stations are just as unsightly as solar panels is, but more and also take up a lot of space. While there are drawbacks to using solar panels, they are more sustainable and therefore more reliable in the long run, which makes them better to use than gas-burning power stations. [6] |
| | | | Total | 6 | |