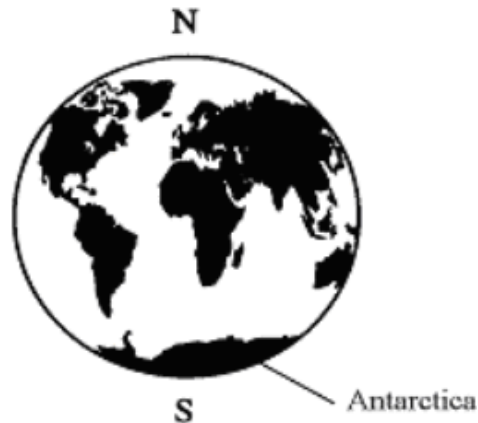
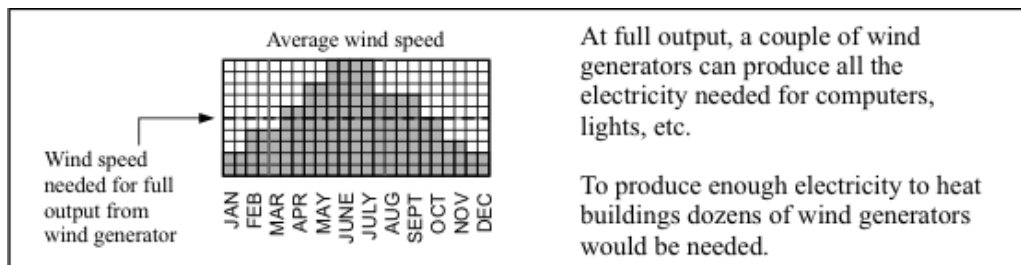
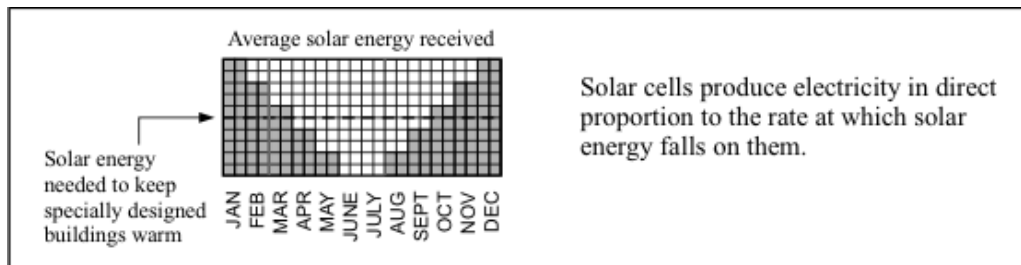


- Q1.** Antarctica is a huge land mass surrounding the Earth's south pole. It is covered in a very thick layer of ice and is the only remaining large area of the Earth's surface that has not been affected very much by humans.



There are, however, teams of scientists from various countries studying Antarctica. These scientists need electricity for lighting, for their computers and other scientific instruments and to communicate, via satellite, with the rest of the world. The temperature in Antarctica is always sub-zero, so the scientists need some way of keeping their buildings warm. They also need fuel to be able to get around on their snowmobiles.

Scientists cannot avoid affecting the environment. However, they want to affect it as little as possible.



Atmospheric pollution produced in one country eventually affects the whole of the Earth's atmosphere. The hole that appears each year in the ozone layer above Antarctica, for example, is mainly caused by pollutants such as CFCs from countries in the northern half of the Earth.

Discuss the advantages and disadvantages of using the following energy sources to meet the scientists' needs:

- solar energy
- energy from the wind
- natural gas (present in large quantities deep down in the Antarctic land mass)
- diesel oil (which would have to be imported)

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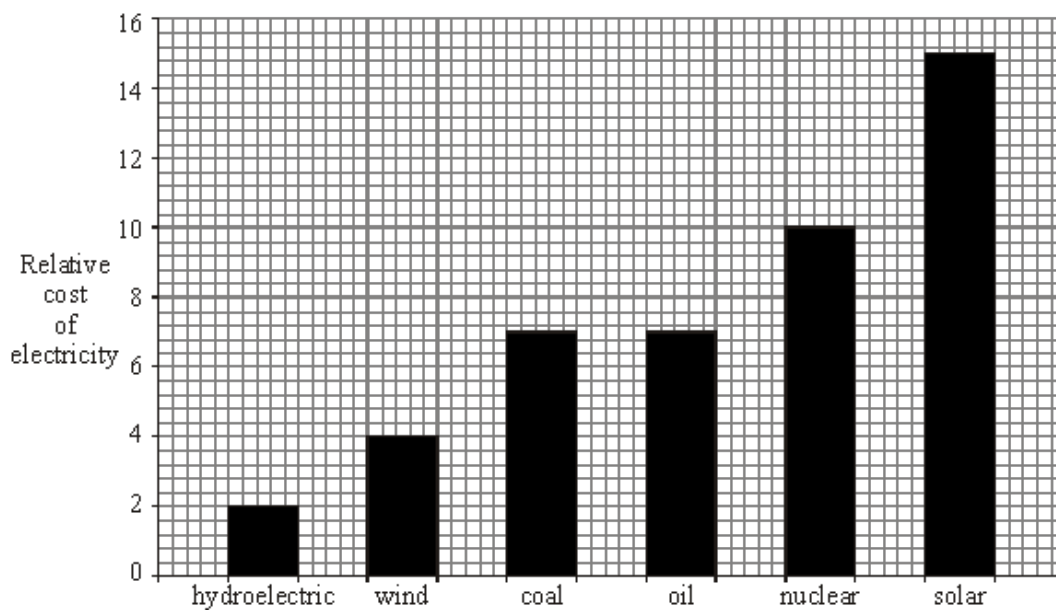
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(Total 10 marks)

**Q2.** The bar chart shows the relative costs of some different energy sources that are used to generate electricity.



- (a) Apart from cost, give **two** advantages that a hydroelectric power station has compared with a wind farm.

1 .....

.....

2 .....

.....

(2)

- (b) Apart from cost, give **one** advantage and **one** disadvantage that a nuclear power station has compared with a coal-fired power station.

Advantage .....

.....

Disadvantage .....

.....

(2)

- (c) State and explain **one** situation where it is better to use solar energy, rather than any of the other energy sources, to generate electricity.

.....

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(2)

(Total 6 marks)

**Q3.** Different energy sources are shown in the box.



An 'Eco-home' is one which is friendly to the environment.

Imagine you are designing an 'Eco-home' which can use any of the energy sources above to generate electricity

- (a) Choose **one** non-renewable energy source from the box above that could provide the electricity supply to your 'Eco-home', but which would be **unsuitable**.

Write the energy source in the table and explain, as fully as you can, why it is **unsuitable** for an 'Eco-home'.

Non-renewable energy source	Unsuitable for an 'Eco-home' because
.....	.....
.....	.....
	.....
	.....
	.....
	.....
	.....
	.....

(2)

- (b) Choose **two** suitable renewable energy sources from the box opposite that could provide an electricity supply to your 'Eco-home'.

Write the two energy sources in the table and describe, in as much detail as you can, the undesirable environmental effects of using these.

Renewable energy source	Undesirable environmental effects
<b>1</b>   	       
<b>2</b>   	       

(4)  
(Total 6 marks)

- Q4.** Use of renewable sources of energy is expected to increase. The table shows the comparative costs of producing 1 kWh of electricity from different energy sources.

Types of energy sources used in the UK	Cost of producing 1 kWh of electrical energy	
Fossil fuels (non-renewable)	Coal	1.0 p
	Gas	1.4 p
	Oil	1.5 p
Nuclear fuels (non-renewable)	Nuclear	0.9 p
Renewable	Hydroelectric	0.2 p
	Wind	0.9 p
Installation and decommissioning costs are not included		

At present about 2% of electricity generated in the UK uses renewable energy sources. Consider the three types of energy sources in the table and give **one** advantage and **one** disadvantage for each (other than installation and decommissioning costs).

Advantage	Disadvantage
Using fossil fuels ..... ..... .....	Using fossil fuels ..... ..... .....
Using nuclear fuels ..... ..... .....	Using nuclear fuels ..... ..... .....
Using renewable sources ..... ..... .....	Using renewable sources ..... ..... .....

(Total 6 marks)

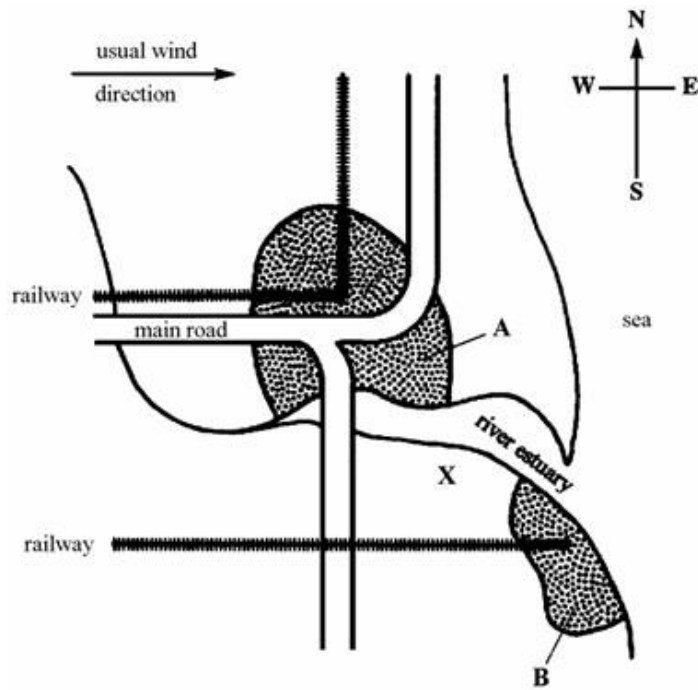
- Q5.** The map below shows the position of two towns, **A** and **B**, on the banks of a large river estuary.

A is an important fishing and ferry port.

The wind usually blows from the west. The major roads and railways are shown.

A power station is to be built in area X to generate electricity for the region.

The choice is between a nuclear power station and a coal fired power station.



- (a) State the advantages and disadvantages of the two methods of generating electrical energy.

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(6)

(b) Which method would you choose for this site?

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Explain the reason for your choice.

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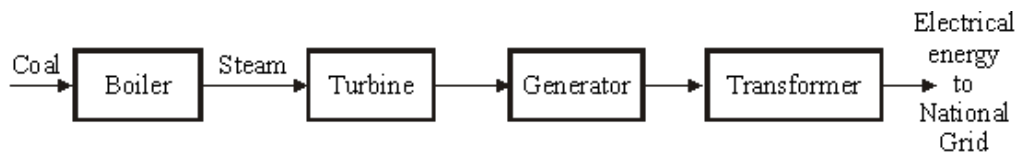
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(3)  
(Total 9 marks)

**Q6.** The diagram below shows four stages in the production of electricity by a coal-fired power station.



(a) (i) Write down **two** environmental problems which are caused by burning coal to generate electricity.

1 .....

.....

.....

2 .....

.....

.....

(ii) How may these environmental problems be reduced?

1 .....

.....

.....



2 .....  
.....  
.....

(4)

(b) Some data for Didcot coal-fired power station is given below.

Number of generators	4
Maximum continuous power rating of a generator	500 MW at 23 500 V
Energy content of coal used	$2.66 \times 10^{10}$ J per tonne
Total quantity of coal used each day	18 289 tonnes

Use the given data to calculate:

(i) the total electrical energy output each day.

.....  
.....  
.....

Answer .....J/day

(ii) the total input of coal energy each day.

.....  
.....  
.....

Answer .....J/day

(iii) the efficiency of the power station.

.....  
.....  
.....

Answer ..... %

(8)

(c) Energy is conserved.

(i) Choose **one** of the stages in the diagram at the start of the question.  
State what happens to the wasted energy during this stage.

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.....  
.....

(ii) Explain what happens to all wasted energy during energy transfers.

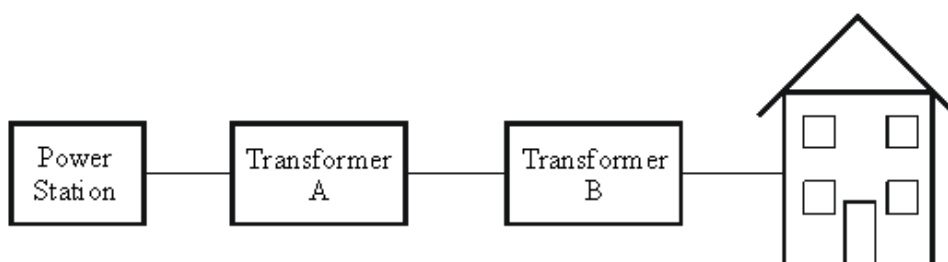
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(3)  
(Total 15 marks)

**Q7.**



Transformer A produces a very high voltage to transmit the electrical energy through the National Grid.

Explain why electrical energy is transmitted at a very high voltage.

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(Total 3 marks)

**Q8.** Describe, in as much detail as you can, how the energy stored in coal is transferred into electrical energy in a power station.

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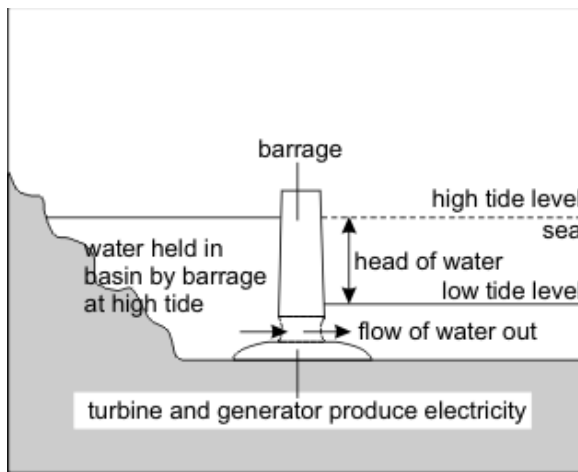
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(Total 5 marks)

**Q9.** The outline diagram below shows a tidal power generating system.



Gates in the barrage are open when the tide is coming in and the basin is filling to the high tide level. The gates are then closed as the tide begins to fall.

Once the tide outside the barrage has dropped the water can flow through large turbines in the barrage which drive generators to produce electrical energy.

In one second  $1.2 \times 10^9$  kg of water flows through the turbines at a speed of 20 m/s.

- (a) When used with a water speed of 20 m/s the system has an efficiency of 90% in converting the kinetic energy of the water into electrical energy. Calculate the power output of the generators.

.....

.....

.....

(2)

- (b) The power output of a coal fired power station is 1000 MW ( $1 \times 10^9$  W).

- (i) Suggest **two** advantages of coal fired power stations over tidal power generating systems.

1. ....

.....

2. ....

.....

- (ii) Suggest **two** advantages of tidal power generating systems over coal fired power stations.

1. ....

.....

2. ....

.....

- (iii) Suggest and explain **one** disadvantage of a tidal power generating system.

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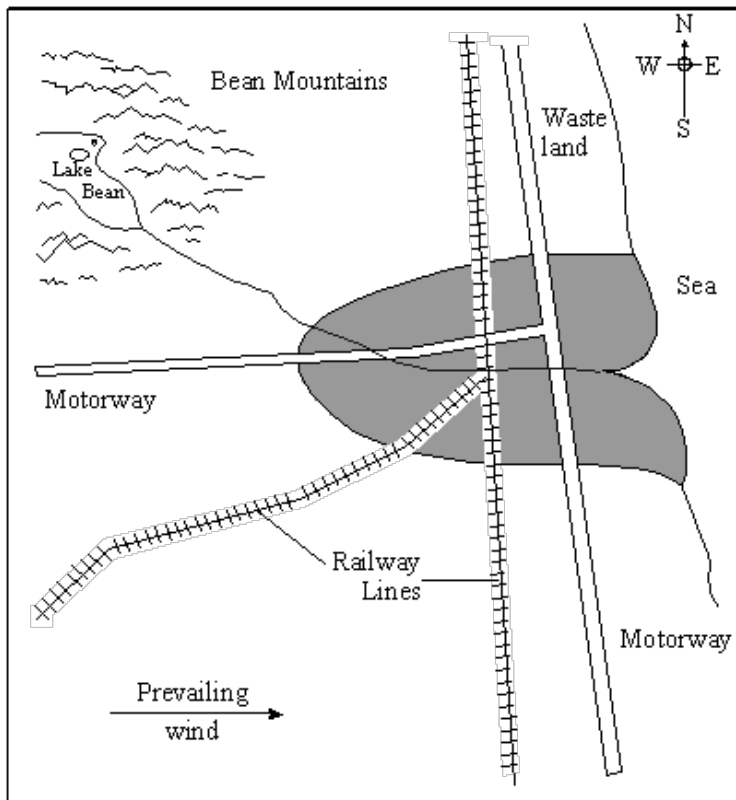
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(6)

(Total 8 marks)

**Q10.** The map below shows an industrial region (shaded).



The prevailing wind is from the west. There is a nearby mountainous area, from which a river flows through the region. The major road and rail links are shown.

A power station is to be built to supply electrical energy to the region. The energy will be for a range of domestic and industrial uses.

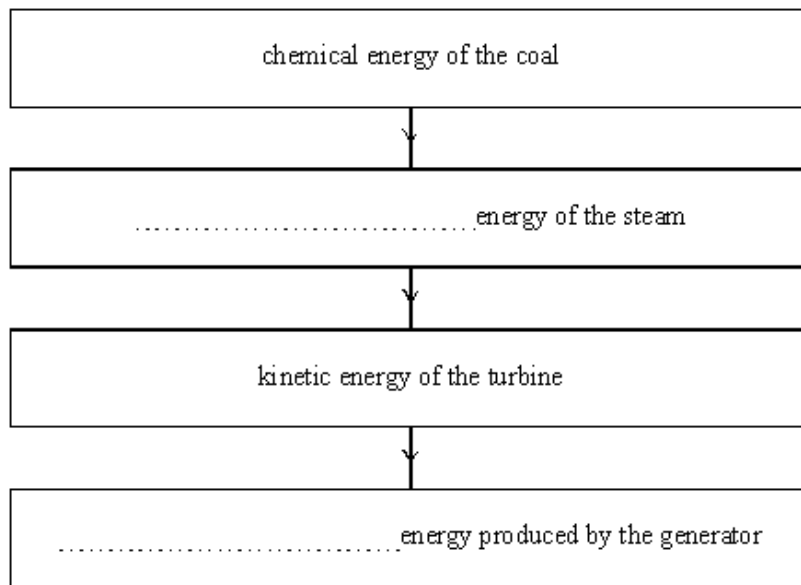
The choice is between a coal fired power station, wind turbines and a hydroelectric scheme.

Three local groups each support a different option. Choose which option you would support and justify your choice by making reference to the financial, social and environmental implications of your choice compared with those of the alternative systems.

**(Total 8 marks)**

**Q11.** (a) Most electricity in Britain is generated by coal fired power stations.

Complete the sequence of useful energy transfers which take place in the power station.



(1)

(b) The diagram shows a wind turbine which is used to produce electricity using energy from the wind.



(i) What is the source of energy which creates winds?

.....

(1)

(ii) Explain the advantage of using a wind turbine to produce electricity.

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(2)

(Total 4 marks)

**Q12.** (a) Explain how energy is produced in the Sun.

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(3)

(b) Read the following article that appeared in a magazine.

“Conservation of energy is important in today’s society. Energy sources, such as oil and coal, which have been used for the development of an industrial society, cannot be relied upon as heavily in the future. Renewable energy sources cannot provide such large quantities of energy for society without causing problems.”

(i) Give **two** reasons why oil should not be relied on as a major source of energy for the future.

1 .....

.....

2 .....

.....

(2)

(ii) Energy from the wind is a renewable energy resource. State **three** problems which may arise if the wind were to be used to meet the energy requirements of a large industrial city in Britain.

1 .....

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2 .....

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3 .....

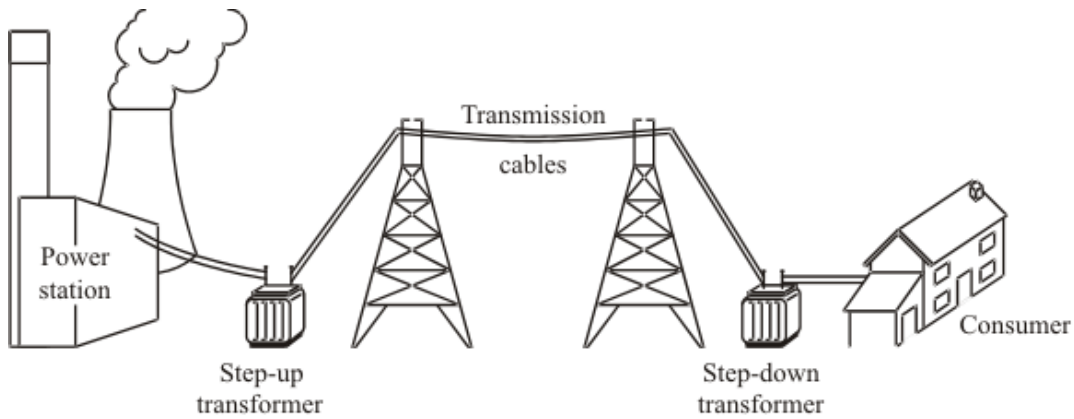
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(3)

(Total 8 marks)

**Q13.** The diagram shows how electricity is distributed from power stations to consumers.



- (a) (i) What name is given to the network of cables and transformers that links power stations to consumers?

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(1)

- (ii) What does a step-up transformer do?

.....

(1)

- (iii) Explain why step-up transformers are used in the electricity distribution system.

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(2)

- (b) Most of the world's electricity is generated in power stations that burn fossil fuels.  
State **one** environmental problem that burning fossil fuels produces.

.....

.....

(1)



- (c) Electricity can be generated using energy from the wind. A company wants to build a new wind farm. Not everyone thinks that this is a good idea.



- (i) What arguments could the company give to persuade people that a wind farm is a good idea?

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(2)

- (ii) What reasons may be given by the people who think that wind farms are **not** a good idea?

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(2)

(Total 9 marks)

**Q14.** There is an increasing demand for electricity and the reserve of fossil fuels is decreasing. A way to meet increasing demand for electricity is to build new nuclear power stations. Some people feel that no new nuclear power stations should be built because of the risks associated with nuclear fuels.

- (a) Outline the arguments that a scientist working in the nuclear power industry could use to justify the building of more nuclear power stations in the future.

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(3)

- (b) Nuclear waste is a problem that must be dealt with. One possible solution would be to bury the waste deep underground.

Suggest **one** reason why some people are against burying nuclear waste.

.....

.....

(1)

- (c) Electricity can also be generated using renewable energy sources.

Look at this information from a newspaper report.

- The energy from burning bio-fuels, such as woodchip and straw, can be used to generate electricity.
- Plants for bio-fuels use up carbon dioxide as they grow.
- Farmers get grants to grow plants for bio-fuels.
- Electricity generated from bio-fuels can be sold at a higher price than electricity generated from burning fossil fuels.
- Growing plants for bio-fuels offers new opportunities for rural communities.

Suggest why, apart from the declining reserves of fossil fuels, power companies should use more bio-fuels and less fossil fuels to generate electricity.

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(3)  
(Total 7 marks)

**Q15.** (a) Solar energy is a *renewable* energy source that can be used to generate electricity.

- (i) What is meant by an energy source being *renewable*?

.....

(1)

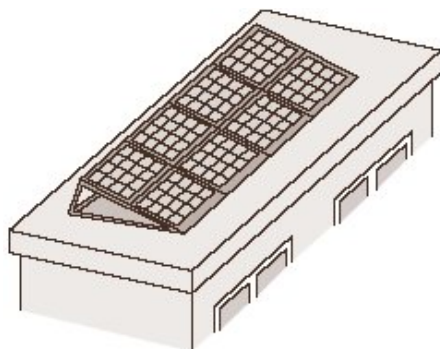
- (ii) Name **two** further renewable energy sources used to generate electricity.

1 .....

2 .....

(1)

- (b) A householder uses a bank of solar cells to generate electricity for his home. The solar cells are tilted to receive the maximum energy input from the Sun.



The data in the table gives the average energy input each second (in J/s), to a  $1 \text{ m}^2$  area of solar cells for different angles of tilt and different months of the year.

Month	Angle of tilt			
	$20^\circ$	$30^\circ$	$40^\circ$	$50^\circ$
February	460	500	480	440
April	600	620	610	600
June	710	720	680	640
August	640	660	640	580
October	480	520	500	460
December	400	440	420	410

- (i) Use the data in the table to describe how the average energy input to the solar cells depends on the angle of tilt.

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(2)

- (ii) The bank of solar cells used by the householder has an area of 8 m<sup>2</sup>.

The efficiency of the solar cells is 0.15

Use the equation in the box to calculate the average **maximum** electrical energy available from the bank of solar cells each second in June.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

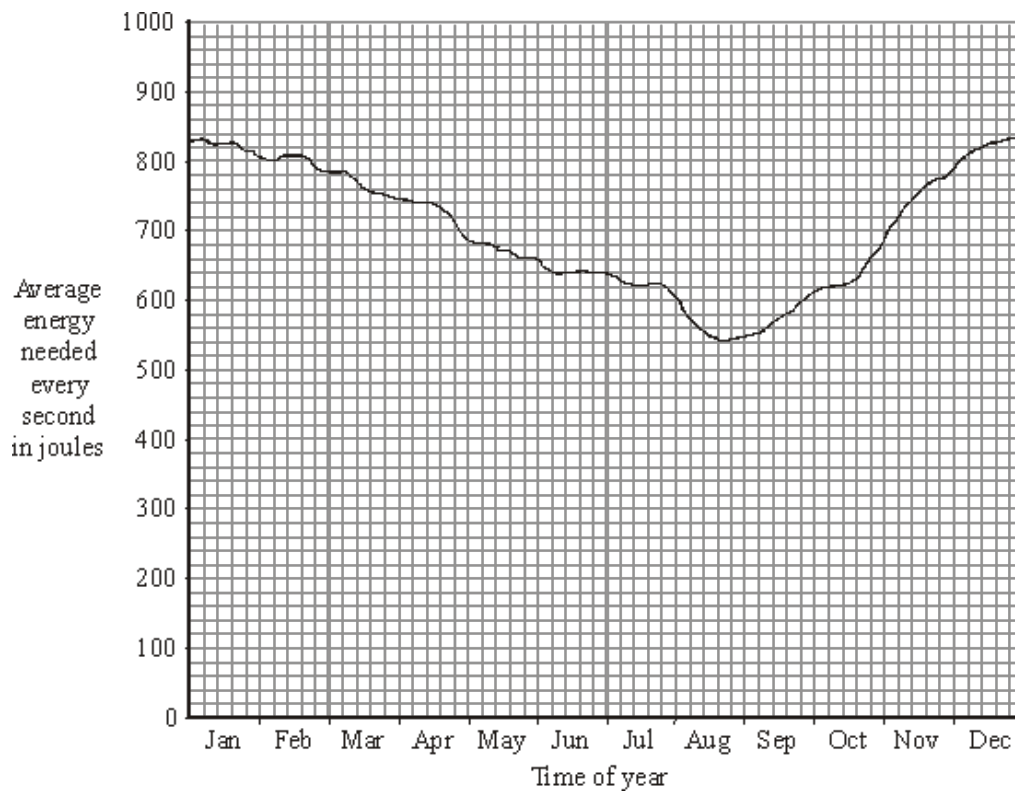
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Maximum energy = ..... joules/second

(3)

(c) The graph shows how the householder's electrical energy needs change over one year.

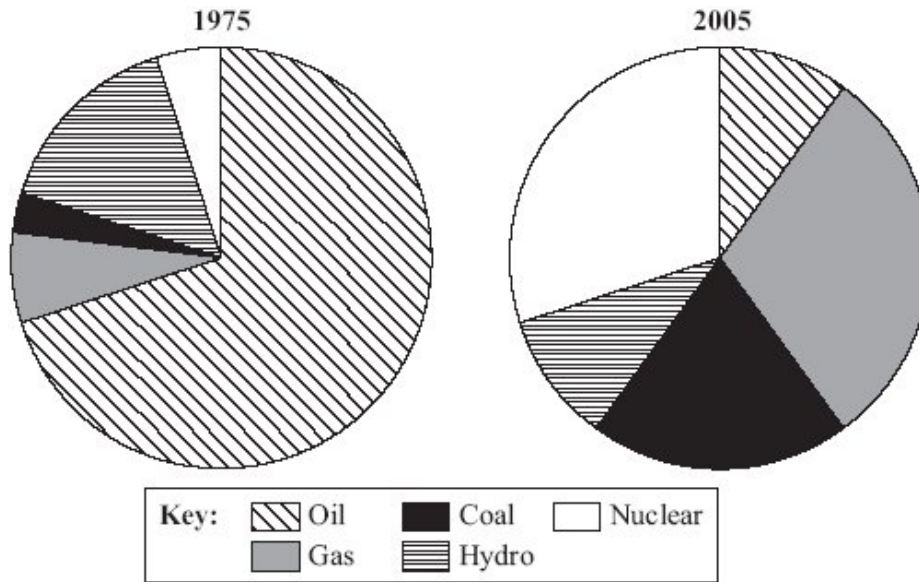


Why would it be advisable for the householder to remain connected to the National Grid?

.....  
.....

(1)  
(Total 8 marks)

- Q16.** The pie charts show the relative proportions of electricity generated in Japan from different energy sources in 1975 and 2005.



- (a) Describe the main differences in the energy sources used in 2005 compared with 1975.

.....  
 .....

(1)

- (b) In the UK, nuclear fuels are used to generate about 21% of the total electricity supply.

- (i) What is the name of the process by which a nuclear fuel produces heat?

.....

(1)

- (ii) Explain how the heat released from a nuclear fuel is used to generate electricity in power stations.

.....  
 .....  
 .....  
 .....

(2)

- (iii) Some people have suggested that more nuclear power stations should be built in the UK.

Give **two** reasons to support this suggestion.

1 .....

.....

2 .....

.....

(2)

- (iv) Nuclear power stations create dangerous waste.

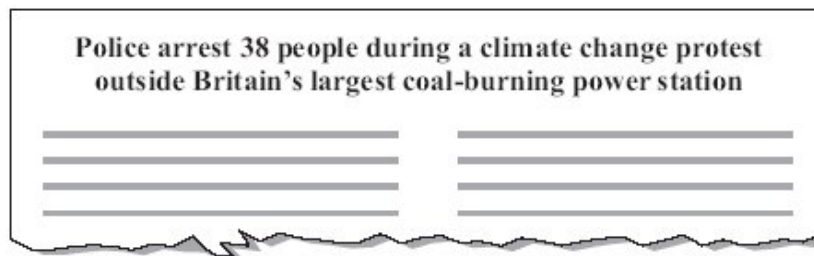
Why is the waste from a nuclear power station dangerous?

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.....

(1)

- (c) A headline from a newspaper article is shown below.



Explain the possible link between *climate change* and *coal-burning power stations*.

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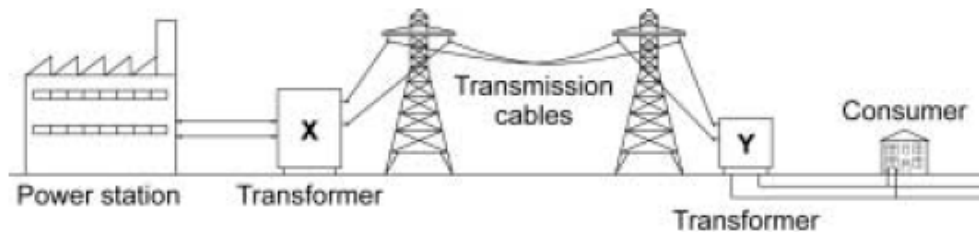
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(2)

(Total 9 marks)



**Q17.** The diagram shows the National Grid system.



Transformers **X** and **Y** are an essential part of the National Grid system.

Explain why.

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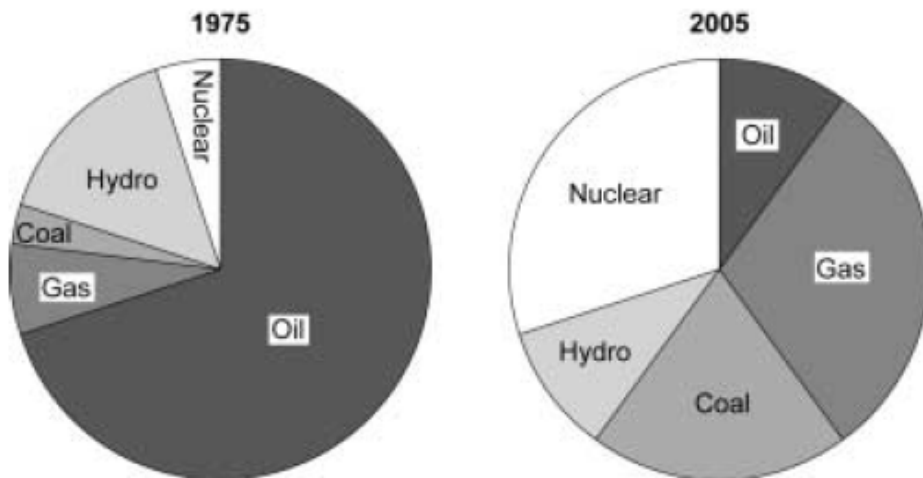
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**(Total 4 marks)**

**Q18.** The pie charts show the relative proportions of electricity generated in Japan from different energy sources in 1975 and 2005.



- (a) Describe and suggest a reason for **two** differences in the energy sources used in 2005 compared with 1975.

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.....

.....

(2)

- (b) Mining for coal often releases large amounts of methane gas. Methane is both explosive and a greenhouse gas. At the Sihe coal mine in China the methane is diverted to a gas burning power station where it is used to generate electricity.

- (i) A newspaper reported a scientist as saying:

If the concentration of greenhouse gases in the atmosphere doubles, the average temperature of the Earth will increase by up to 5 °C over the next 100 years.

What has been stated in the newspaper?

Draw a ring a round your answer.

**a fact**

**a guess**

**a prediction**

Give a reason for your answer.

.....

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.....

(2)

- (ii) Explain an environmental advantage of taking the methane gas from coal mines and using it to generate electricity.

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(2)

- (c) The average person in Britain uses 1930 kWh of electricity each year. Many people in the world's poorest countries do not have access to electricity.

Giving examples, explain why electricity is essential for both improving public health and for modern communications.

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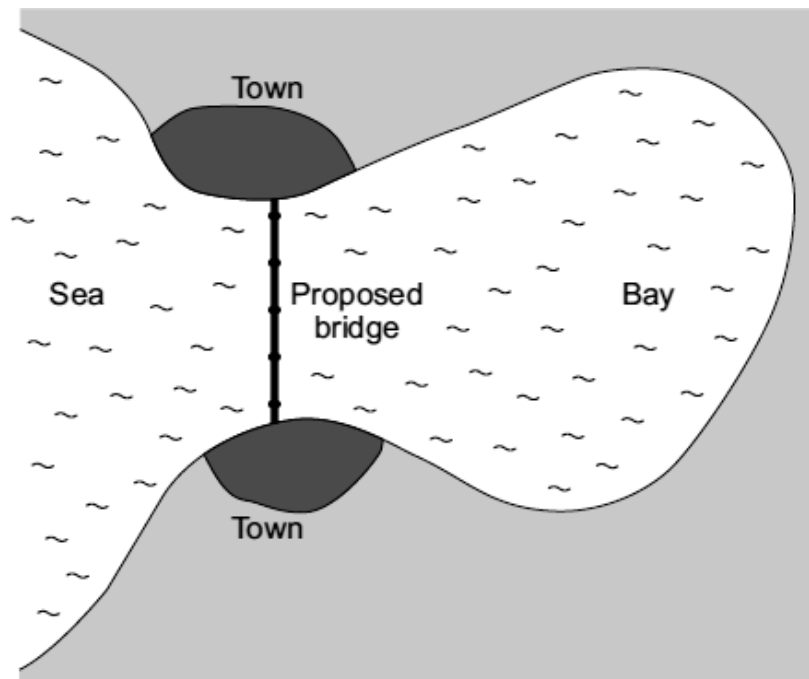
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(3)  
(Total 9 marks)

- Q19.** The map shows the positions of two towns on either side of a very large coastal bay in England. The map also shows where a bridge may be built to link the towns. The road journey from one town to the other is about 60 kilometres at present.



- (a) It is estimated that building turbines and generators inside the legs of the bridge would produce enough electricity for both towns. In addition, enough electricity would be generated to run electric buses over the bridge between the two towns.
- (i) If the bridge is built, what form of renewable energy will be used to generate the electricity?

.....

(1)

- (ii) Most people living in the area are in favour of the proposed bridge.

Suggest **three** reasons why people would be in favour of building the bridge and the associated electricity generating scheme.

Reason 1 .....

.....

Reason 2 .....

.....

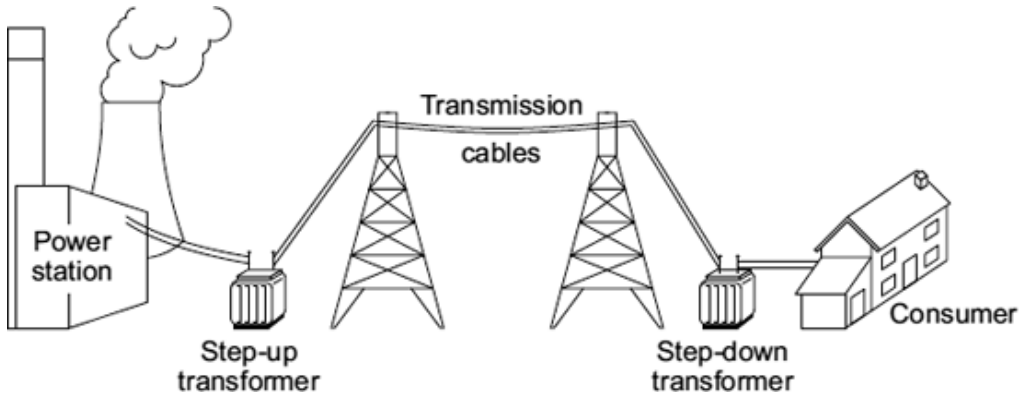
Reason 3 .....

.....

(3)

- (b) Even with the proposed bridge, the two towns will need to stay connected to the National Grid.

The diagram shows part of the National Grid.



- (i) Give **one** reason why the towns need to stay connected to the National Grid.

.....

.....

(1)

- (ii) Explain how the step-up transformer increases the efficiency of the National Grid.

.....

.....

.....

.....

(2)

(Total 7 marks)

**Q20.** Over the next 15 years, some of the older nuclear power stations will be closed down, and the process of *decommissioning* will start. In the same period, several countries plan to build a number of new nuclear power stations.

- (a) (i) What does it mean to *decommission* a nuclear power station?

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 .....

(1)

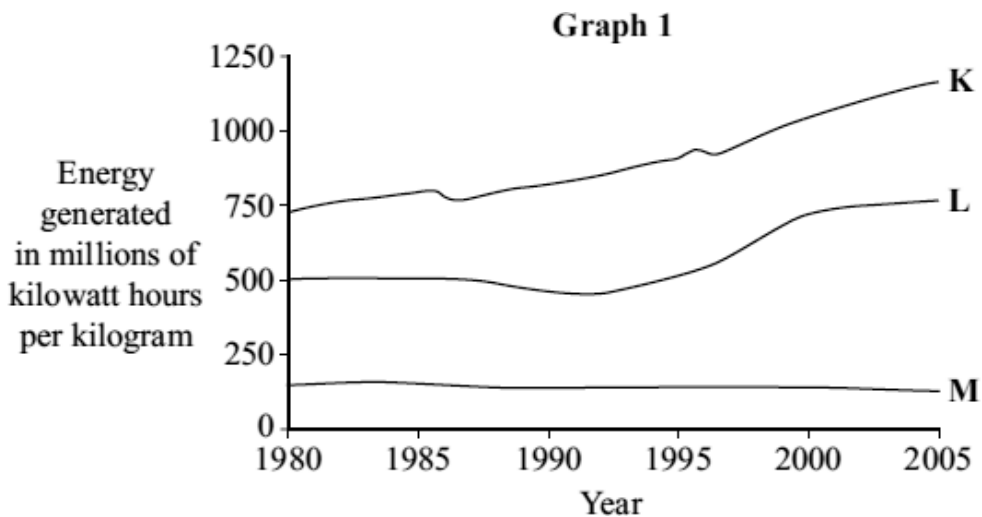
- (ii) How does *decommissioning* affect the overall cost of electricity generated using nuclear fuels?

.....  
 .....

(1)

- (b) Uranium is a fuel used in nuclear power stations to generate electricity.

**Graph 1** compares how the electricity generated from one kilogram of nuclear fuel changed between 1980 and 2005 in three different types of nuclear power station.

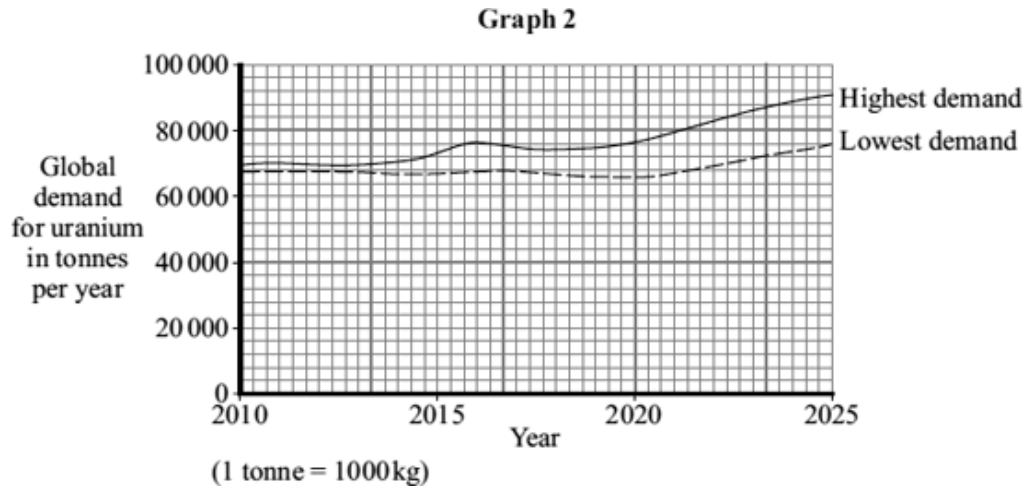


- (i) Compare the efficiency of the three types of power station, **K**, **L** and **M**, between 1980 and 2005.

.....  
 .....  
 .....  
 .....

(2)

**Graph 2** shows two different predictions for the global growth in uranium demand over the next 15 years.



- (ii) Suggest reasons why it is **not** possible to predict accurately how much uranium will be needed in 2025.

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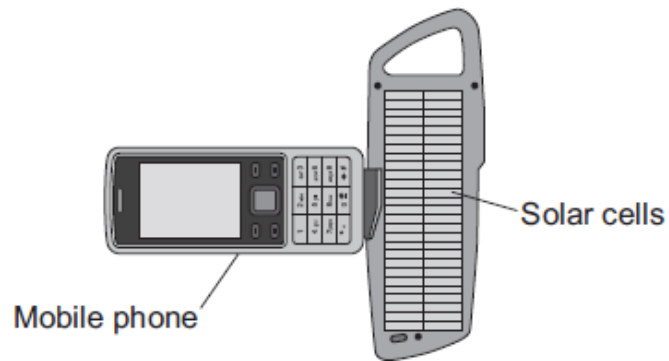
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(2)  
(Total 6 marks)

- Q21.** (a) The diagram shows a solar powered device being used to recharge a mobile phone.



On average, the solar cells produce 0.6 joules of electrical energy each second.  
The solar cells have an efficiency of 0.15.

- (i) Use the following equation to calculate the average energy input each second to the device.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....  
.....

Average energy input each second = ..... J/s

(2)

- (ii) Draw a labelled Sankey diagram for the solar cells.  
The diagram does **not** need to be drawn to scale.

(1)

(iii) Energy from the Sun is stored by a rechargeable battery inside the device.

Suggest **one** factor that would affect the time it takes to fully charge the battery.

Give a reason for your answer.

.....

.....

.....

.....

(2)

(b) Scientists have developed a new type of solar cell with an efficiency of over 40 %.  
The efficiency of the solar cell was confirmed independently by other scientists.

Suggest why it was important to confirm the efficiency independently.

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.....

(1)

(c) The electricity used in homes in the UK is normally generated in a fossil fuel power station.

Outline some of the advantages of using solar cells to generate this electricity.

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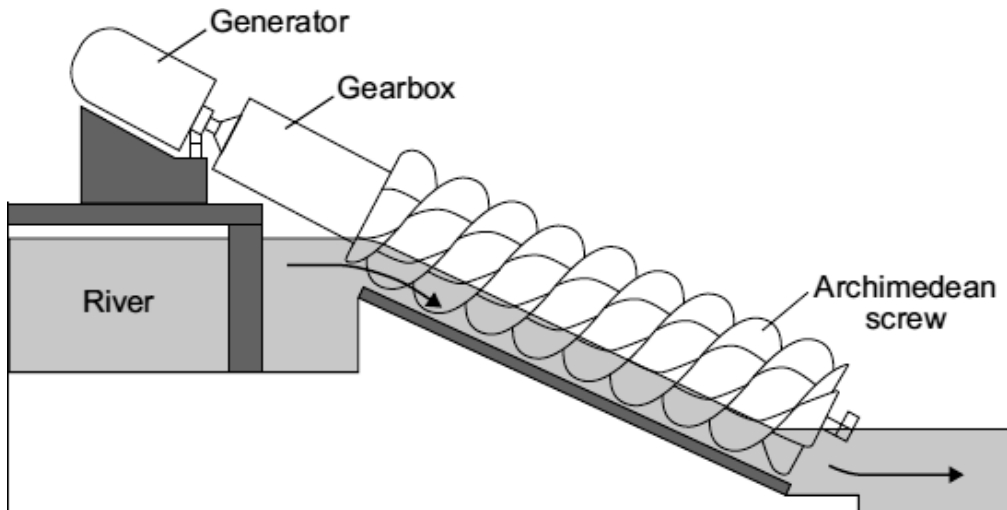
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(2)

(Total 8 marks)

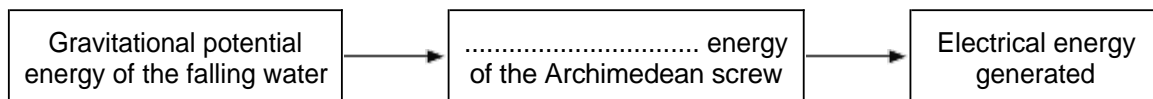


- Q22.** The diagram shows a small-scale, *micro-hydroelectricity* generator which uses the energy of falling river water to generate electricity. The water causes a device, called an Archimedean screw, to rotate. The Archimedean screw is linked to the generator by a gearbox.



- (a) Each second, the *micro-hydroelectricity* generator transforms 80 000 joules of gravitational potential energy into 60 000 joules of electrical energy.

- (i) Fill in the missing word to complete the energy transformation diagram.



(1)

- (ii) Use the equation in the box to calculate the efficiency of the *micro-hydroelectricity* generator.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....  
 .....

Efficiency = .....

(2)

- (b) The power output from a conventional large-scale hydroelectric power station is 100 000 times more than the power output from a micro-hydroelectric system.

Give **one** disadvantage of a conventional large-scale hydroelectric power station compared to the micro-hydroelectric system.

.....  
 .....

(1)

- (c) The electricity generated by a micro-hydroelectric system is transferred via a transformer directly to local homes. The electricity generated by a conventional large-scale hydroelectric power station is transferred to the National Grid, which distributes the electricity to homes anywhere in the country.

(i) What is the National Grid?

.....  
.....

(1)

(ii) Explain why transferring the electricity directly to local homes is more efficient than using the National Grid to distribute the electricity.

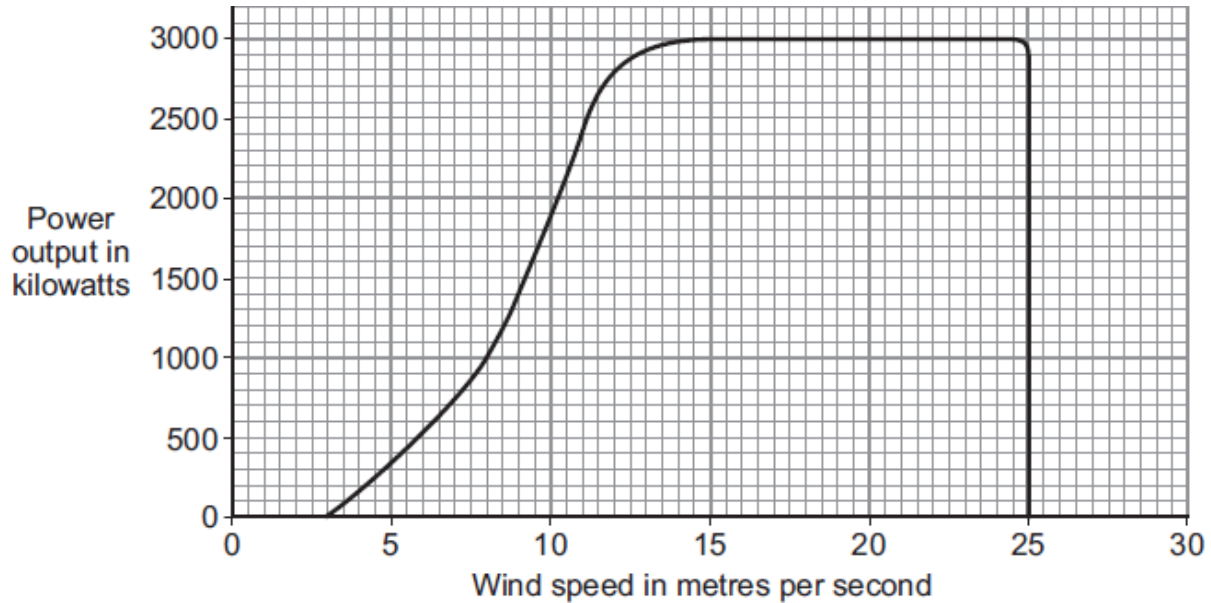
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(2)

(Total 7 marks)

**Q23.** The world's biggest offshore wind farm, built off the Kent coast, started generating electricity in September 2010.

(a) The graph shows how wind speed affects the power output from one of the wind turbines.



In one 4-hour period, the wind turbine transfers 5600 kilowatt-hours of electrical energy.

Use the equation in the box and the data in the graph to calculate the average wind speed during this 4-hour period.

$$\text{energy transferred} = \text{power} \times \text{time}$$

Show clearly how you work out your answer.

.....

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.....

Average wind speed = ..... m/s

(3)

(b) The wind turbines are linked to the National Grid by underwater cables.

(i) What is the National Grid?

.....

.....

(1)

(ii) How is the National Grid designed to reduce energy losses during transmission?

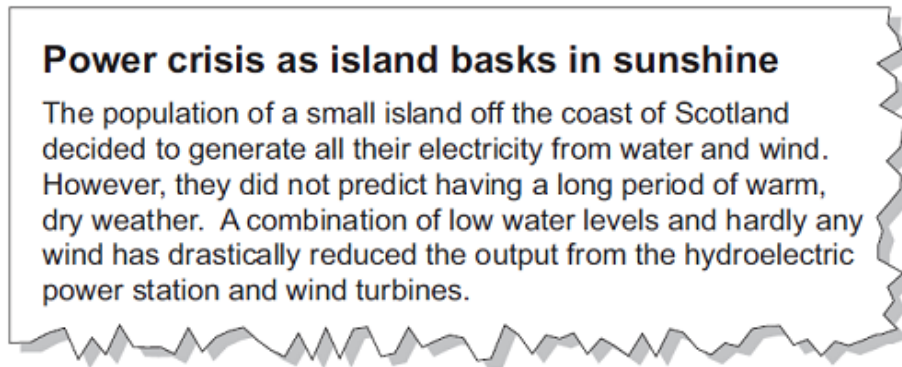
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(1)

(c) Read this extract from a newspaper.



Explain **one** way in which the islanders could try to ensure that a similar power crisis does **not** happen in the future.

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(2)

(Total 7 marks)

- Q24.** (a) Nuclear fuels and the wind are two of the energy sources used to generate electricity in the UK.

Explain the advantages of using energy from nuclear fuels to generate electricity rather than using energy from the wind.

Include in your answer a brief description of the process used to generate electricity from nuclear fuels.

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(4)

- (b) In the UK, most electricity is generated in power stations that emit carbon dioxide into the atmosphere. The impact of these power stations on the environment could be reduced by the increased use of 'carbon capture' technology.

Describe how 'carbon capture' would prevent the build-up of carbon dioxide in the atmosphere.

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(2)

(Total 6 marks)

- Q25.** (a) Solar energy is a *renewable* energy source used to generate electricity.

- (i) What is meant by an energy source being *renewable*?

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.....

(1)

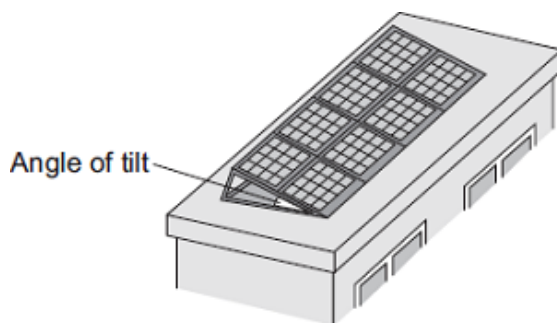
(ii) Name **two** other renewable energy sources used to generate electricity.

1 .....

2 .....

(1)

(b) A householder uses panels of solar cells to generate electricity for his home. The solar cells are tilted to receive the maximum energy input from the Sun.



The data in the table gives the average energy input each second (in J/s), to a 1 m<sup>2</sup> area of solar cells for different angles of tilt and different months of the year.

Month	Angle of tilt			
	20°	30°	40°	50°
February	460	500	480	440
April	600	620	610	600
June	710	720	680	640
August	640	660	640	580
October	480	520	500	460
December	400	440	420	410

(i) Use the data in the table to describe how the average energy input to the solar cells depends on the angle of tilt.

.....

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.....

(2)

- (ii) The total area of the solar cell panels used by the householder is 5 m<sup>2</sup>.

The efficiency of the solar cells is 0.18.

Use the equation in the box to calculate the average **maximum** electrical energy available from the solar cell panels each second in June.

$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$
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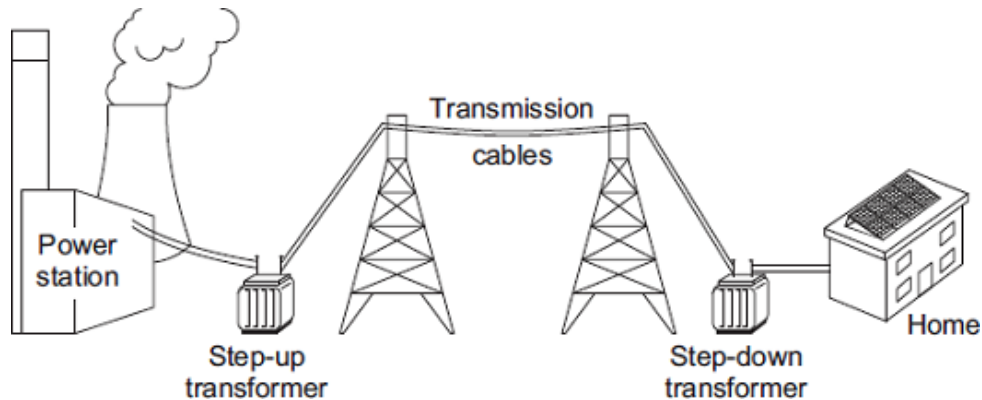
Show clearly how you work out your answer.

.....  
 .....

Maximum energy = ..... joules/second

(3)

- (c) The diagram shows part of the National Grid.



- (i) Even though the householder uses solar cells to generate electricity for his home, the home stays connected to the National Grid.

Give **one** reason why the householder should stay connected to the National Grid.

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 .....

(1)

- (ii) The step-up transformer increases the efficiency of the National Grid.

Explain how.

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(2)

(Total 10 marks)

**Q26.** About half of the UK's electricity is generated in coal-burning power stations and nuclear power stations.

- (a) Coal-burning power stations and nuclear power stations provide a reliable way of generating electricity.

What is meant by a *reliable way of generating electricity*?

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(1)

- (b) Over the next few years, most of the older nuclear power stations in the UK will be closed down, and the process of decommissioning will start.

What does it mean to *decommission* a nuclear power station?

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(1)

- (c) Climate change has been strongly linked to the emission of carbon dioxide. Many governments around the world are committed to reducing carbon dioxide emissions.

Generating electricity can increase carbon dioxide emissions.

The companies generating electricity could reduce carbon dioxide emissions.

Give **two** ways the companies could do this.

1 .....  
.....  
2 .....  
.....

(2)



- (d) Electricity is distributed from power stations to consumers along the National Grid.

The voltage across the overhead cables of the National Grid needs to be much higher than the output voltage from the power station generators.

Explain why.

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(3)  
(Total 7 marks)

- Q27.** (a) In the UK, over 70% of the electricity is generated in power stations that burn fossil fuels.

- (i) Explain **one** effect that burning fossil fuels has on the environment.

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(2)

- (ii) Give **one** way the effect on the environment described in part (a)(i) could be reduced.

Assume the amount of fossil fuels burnt stays the same.

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(1)

- (b) Electricity can also be generated in a pumped storage hydroelectric power station.

An advantage of pumped storage hydroelectric power stations is the short start-up time they have.

- (i) What is the importance of the short start-up time?

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.....

(1)

- (ii) Give **one** other advantage of a pumped storage hydroelectric power station.

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(1)

- (c) Read the extract below from a newspaper article.

In the future it may not be possible to have constant electricity. Families will have to get used to using power when it is available.

- (i) In the UK, the proportion of electricity generated using wind turbines is due to increase a lot. Some opponents of wind turbines think this increase will cause big fluctuations in the electricity supply.

Suggest **one** reason why this may be true.

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(1)

- (ii) Between 2002 and 2008 the amount of electricity used for lighting in homes in the UK decreased.

Suggest **one** reason why.

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.....

(1)

(Total 7 marks)

