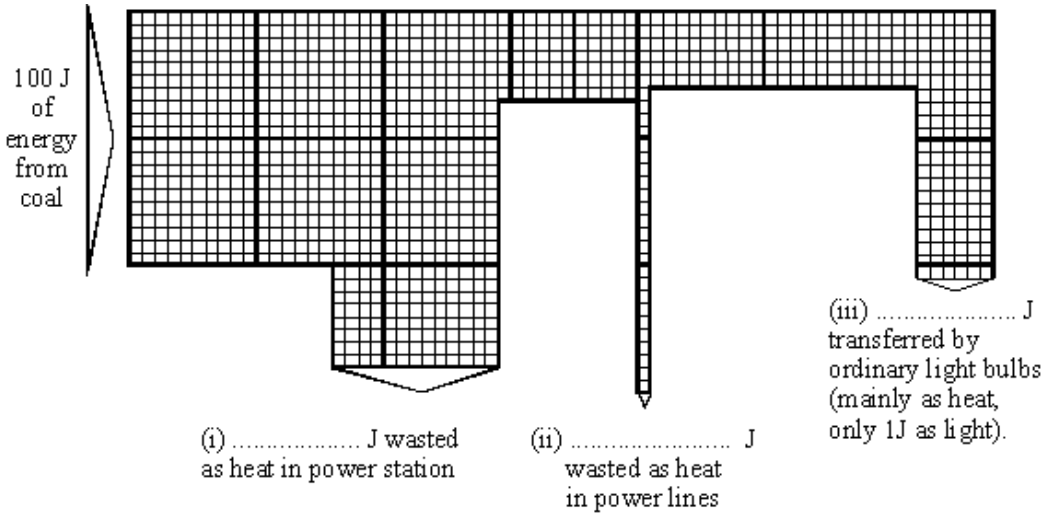
Q1. The diagram shows what happens to each 100 joules of energy from the coal which is burned in a power station when the electricity is used for lighting.



(3)

(a) Add the missing figures to the diagram.

(b) By spending the same amount of money the electricity company could install new power lines which only waste half as much energy as the old ones;

or use a quarter of the heat wasted at the power station to heat schools in a nearby town.

or replace all the light bulbs in everyone's homes with bulbs which produce the same amount of light but use only a fifth as much electricity.
(About 10% of the electricity in homes is used for lighting.)

Which of these two things do you think they should do? Give a reason for your answer.

.....

.....

.....

.....

.....

(4)

(c) You can work out the efficiency of an energy transfer system like this:

$$\text{efficiency} = \frac{\text{useful energy out}}{\text{total energy in}}$$

(i) How efficient are ordinary light bulbs at transferring electrical energy as light?

.....

.....

(1)

(ii) How efficient is **the complete system** at transferring the energy from coal as light when ordinary light bulbs are used?

.....

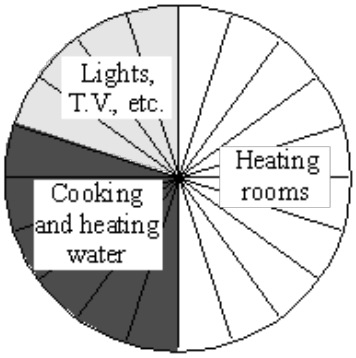
.....

(1)

(Total 9 marks)

Q2. (a) The pie-chart shows how energy is used in a home.

Complete the table using the information on the pie-chart.

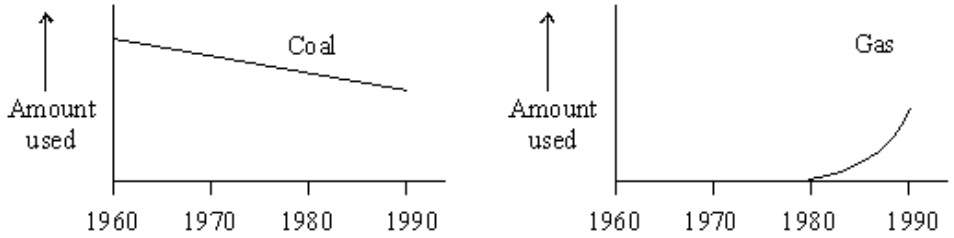


USE OF ENERGY	%
lights, T.V., etc.	20
cooking and heating water	
heating rooms	

(2)

(b) We get some of the energy we need in our homes from electricity.

The graphs show how the amounts of coal and gas used to generate electricity changed between 1960 and 1990.



Describe these changes.

Coal .....

.....

.....

Gas .....

.....

.....

(4)

(c) Read the information below.

- More carbon dioxide in the air may change the weather. Farmers may then not be able to produce the food we need.
- Burning coal produces sulphur dioxide. Burning gas does not do this.
- It is cheaper to generate electricity from gas than from coal.
- Sulphur dioxide causes acid rain which can kill fish and damage buildings.
- Two power stations generate the same amount of electricity. The one which burns gas produces less carbon dioxide than the other which burns coal.

Many people say that the change from coal to gas is better for the environment.

Why do you think they say this?

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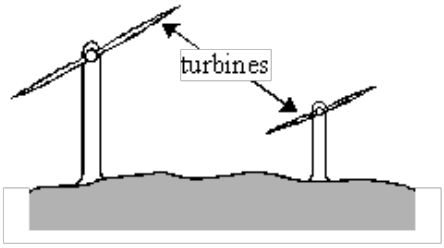
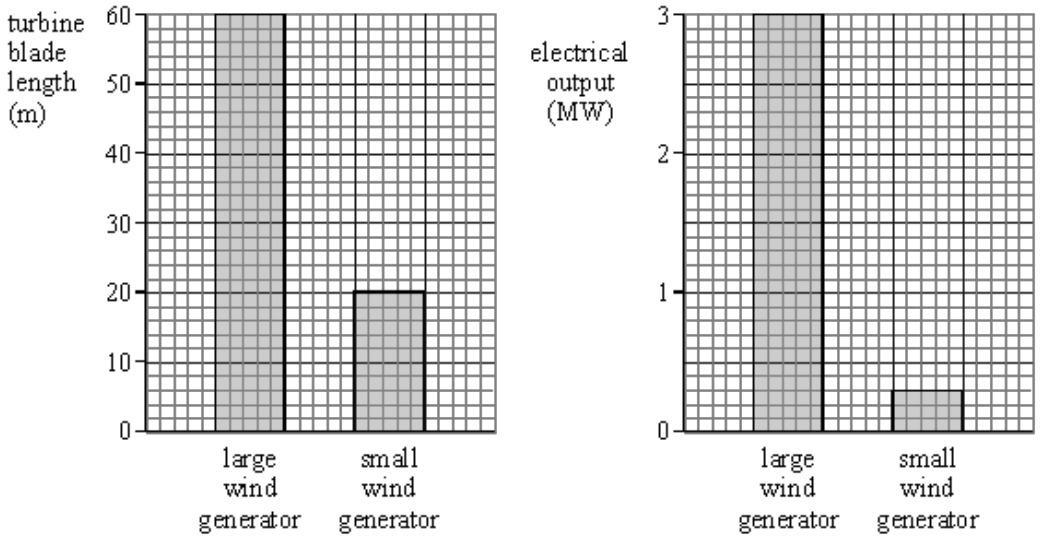
(3)
(Total 9 marks)

Q3. On a very windy hilltop there are two wind generators side by side.



The bar charts show the lengths of the turbine blades and the electrical outputs of the two wind generators.



Complete the following table.

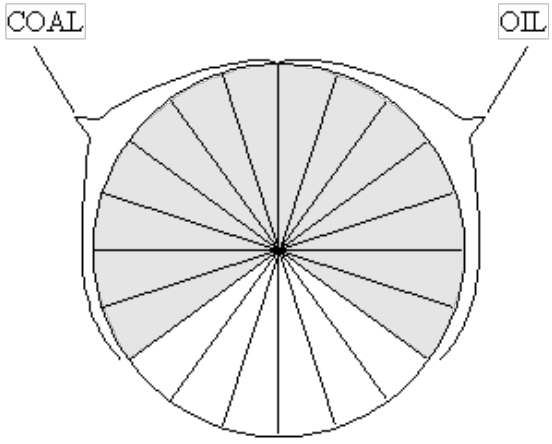
	LENGTH OF TURBINE BLADE (m)	ELECTRICAL OUTPUT (MW)
Large wind generator	60	
Small wind generator		

(Total 3 marks)

Q4. The table shows the main sources of the energy used in Britain in 1990.

coal	35%
oil	35%
gas	24%
nuclear	5%
moving water (hydro)	1%

(a) Finish the pie-chart, using the figures in the table.



(3)

(b) How does the amount of energy obtained from nuclear sources in 1990 compare with the amount obtained from moving water?

.....

.....

(1)

(c) Moving water (hydro) is a renewable energy source.

Write down the name of **one** other renewable energy source.

.....

(1)

(d) Explain why electricity is **not** included in the table of energy sources.

.....

.....

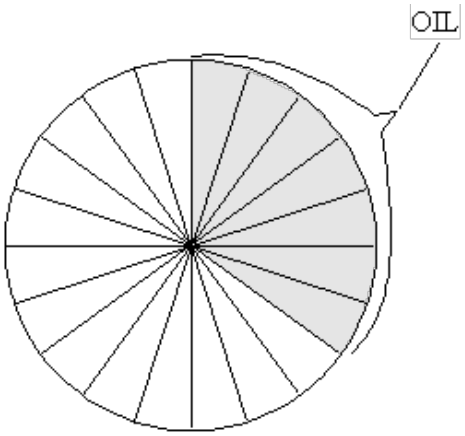
(1)

(Total 6 marks)

Q5. The table shows the main sources of energy used in Britain in 1990.

coal	35%
oil	35%
gas	24%
nuclear	5%
moving water (hydro)	1%

(a) Finish the pie-chart, using the figures in the table.



(4)

(b) Complete the following sentences.

To release energy from coal, gas and oil they must be burned.

Coal, gas and oil are all .....

(1)

(c) Which **one** of the energy sources in the table is renewable? .....

Write down the name of **one** other renewable energy source. .....

(2)

(d) How does the amount of energy obtained from nuclear sources in 1990 compare with the amount obtained from moving water?

.....

.....

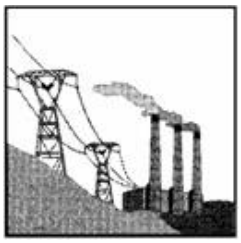
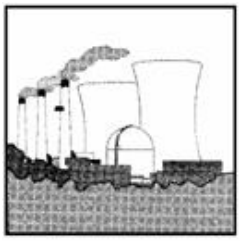
(2)

(Total 9 marks)

Q6. Electricity may be produced from a number of different energy resources.

(i) Complete the table below.

The first one has been done for you.

Device	Energy resource	Useful energy transfer from resource
Coal-fired power station 	Coal	Chemical ⟶ electrical
Hydroelectric power station 	Stored water	..... ⟶ electrical
Solar cell in calculator 	Sun	..... ⟶ electrical
Wind turbine 	Wind	..... ⟶ electrical
Gas-fired power station 	Gas	..... ⟶ electrical

(4)

(ii) Give **one** of the five energy resources opposite, which is **not** classified as renewable.

.....

(1)

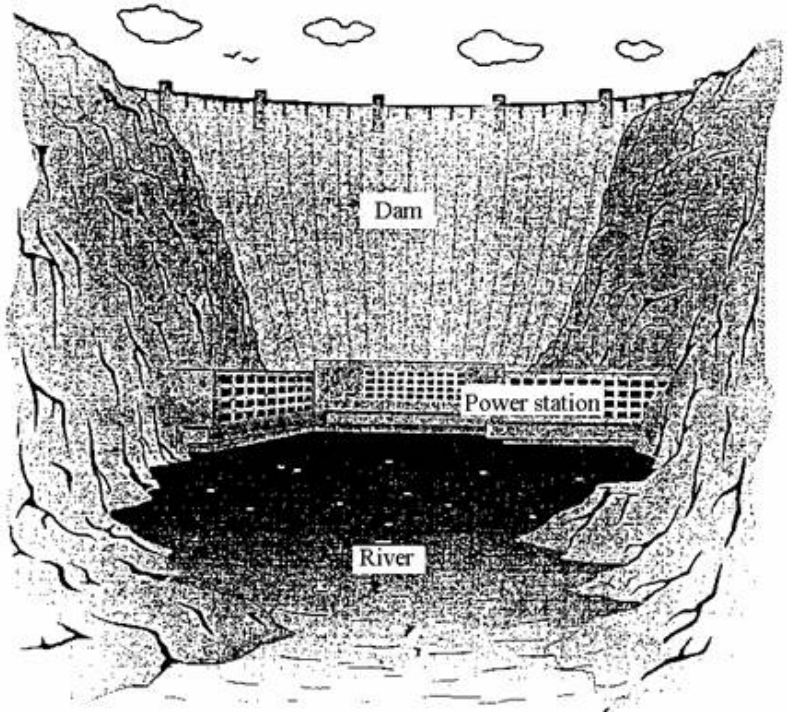
(iii) State another non-renewable energy resource.

.....

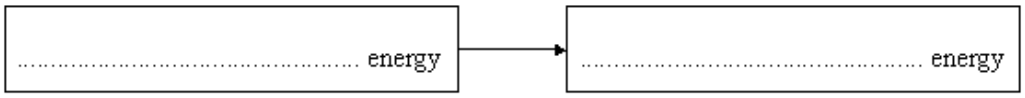
(1)

(Total 6 marks)

Q7. The drawing shows a hydro-electric dam. Water from the top of the dam flows through pipes to the power station at the bottom of the dam.



(a) Complete the following boxes to show the **useful** energy transfer which occurs as the water flows through the pipes **to** the power station.



(2)

(b) The electricity generated by the power station is transmitted over long distances. Before this happens its voltage is increased by using a step-up transformer.

State and explain **one** advantage and **one** disadvantage of transmitting electricity at high voltage.

Advantage .....

.....

.....

.....

(2)

Disadvantage .....

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.....

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(2)

(Total 6 marks)

Q8. State and explain the advantages and disadvantages of using nuclear power stations to produce electricity.

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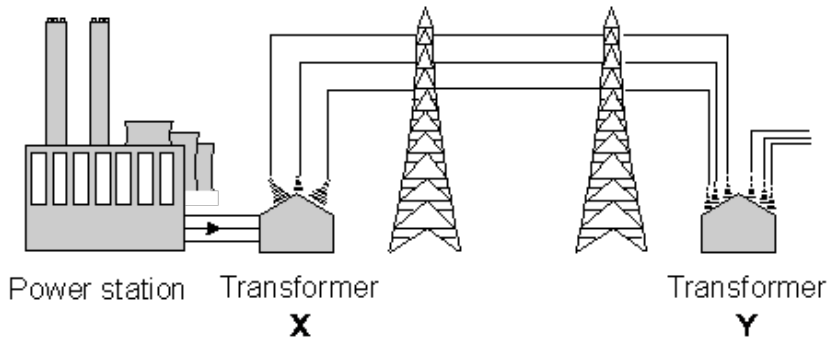
(Total 4 marks)

Q9. The outline diagram below shows part of the National Grid. At **X** the transformer increases the voltage to a very high value. At **Y** the voltage is reduced to 240 V for use by consumers.



(i) At **X** a transformer increases the voltage. What happens to the current as the voltage is increased?

.....

(1)

(ii) Why is electrical energy transmitted at very high voltages?

.....

.....

(1)

(iii) The transformer at **Y** reduces the voltage before it is supplied to houses. Why is this done?

.....

.....

(1)
(Total 3 marks)

Q10. (a) Coal, gas, oil and wood are all examples of fuels.

(i) What are fuels?

.....

(1)

(ii) Write the names of these fuels in the table below to show which are renewable and which are non-renewable.

RENEWABLE FUELS	NON-RENEWABLE FUELS

(2)

(b) The list below shows energy resources which are not fuels.

geothermal nuclear solar tides wind

Write the names of the energy resources in the table below to show which are renewable and which are non-renewable.

RENEWABLE FUELS	NON-RENEWABLE FUELS

(2)

(c) Why is it better to use more renewable energy resources rather than non-renewable resources?

.....

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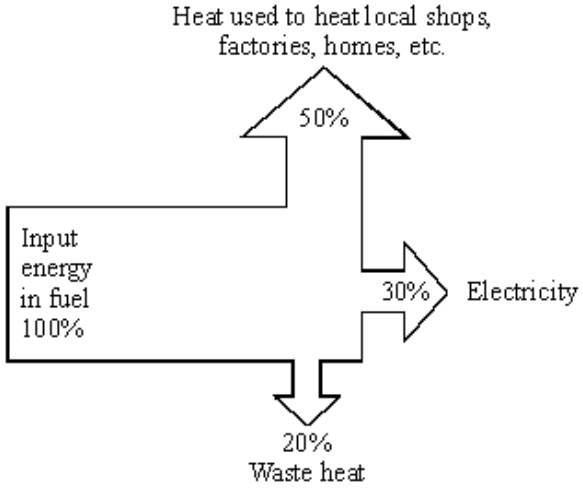
(2)

(Total 7 marks)

Q11. In a traditional power station 30% of the energy input is usefully transferred to electricity, the rest is wasted as heat. The diagram shows the energy transfers in a combined heat and power (CHP) station.



Explain why replacing traditional power stations by CHP stations may be beneficial to the environment.

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(Total 2 marks)

Q12. (a) (i) A student wrote "Coal traps energy from the Sun". Explain what the student means.

.....

.....

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(2)

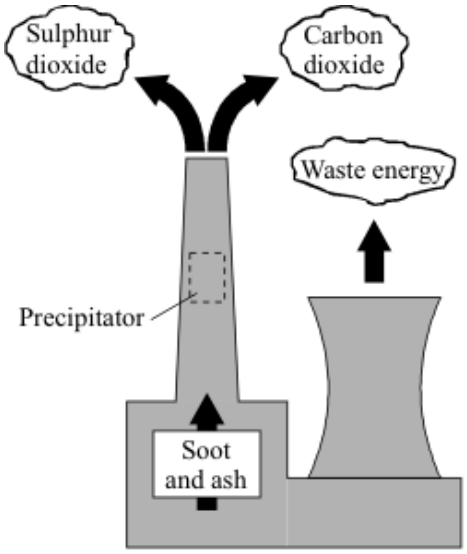
(ii) How is energy released from coal?

.....

.....

(1)

(b) The diagram shows the waste products from a coal-fired power station.



(i) In what form does the power station waste energy?

.....

(1)

(ii) Carbon dioxide released into the atmosphere will lead to a rise in the Earth's temperature. Why?

.....

.....

(1)
(Total 5 marks)

Q13. (a) Electricity is distributed from power stations to consumers along the National Grid.

(i) Transformers are part of the National Grid. Transformers are *efficient* devices. What is meant by a device being *efficient*?

.....

.....

(1)

(ii) When electricity flows through a cable, some energy is transformed into heat.

Explain how the National Grid system reduces the amount of energy lost as heat.

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(2)

(b) Read this information taken from a recent newspaper article.

- Researchers have found that children living close to overhead power cables are more likely to develop leukaemia.
- The researchers studied two groups of children. One group had developed leukaemia, the other group was healthy.
- Although the researchers found a link, they are unable to explain why it happened. They say that the results may have happened by chance.
- Other factors that have not been investigated, such as the environment, the geographical area or the children's genes, could be important.
- A cancer research charity said that childhood leukaemia was most likely to be caused by factors that parents were unable to control.

(i) Why did the researchers study a group of healthy children?

.....

.....

(1)

(ii) The information does not say how many children were studied.

Why should this data have been included in the article?

.....

.....

(1)

(iii) The researchers could not be certain that the overhead power cables were responsible for the increased chance of children developing leukaemia.

Explain why.

.....

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.....

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(2)

(iv) The results of the research carried out by scientists may worry some people.

What do you think scientists should do?

Put a tick (✓) in the box next to your choice.

Scientists should publish their research findings straight away. ☐

Scientists should not publish their research findings until they have found out as many facts as possible. ☐

Give a reason for your choice.

.....

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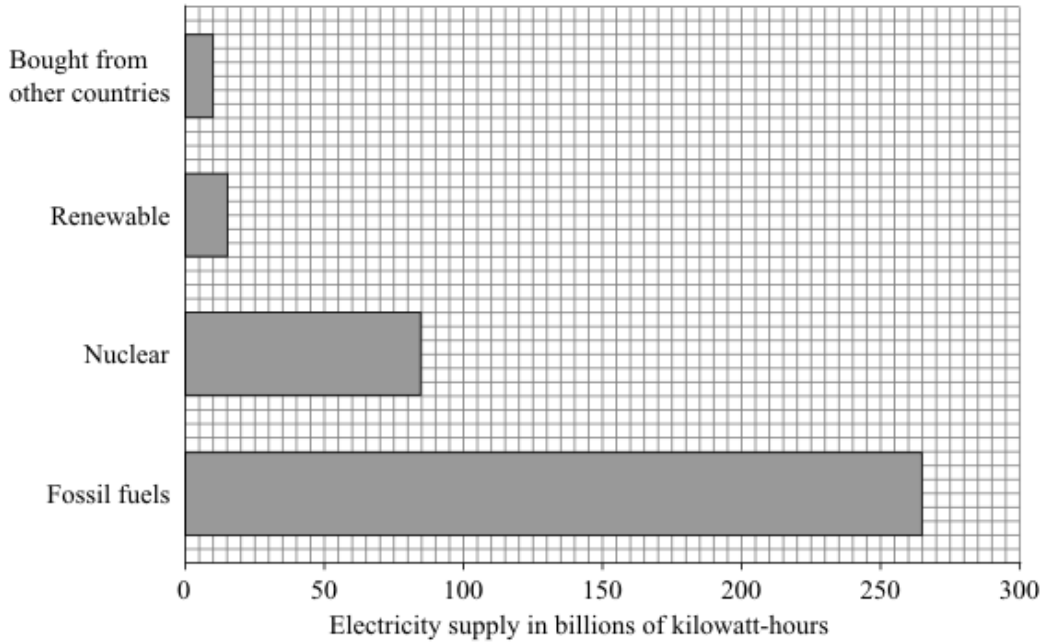
(1)

(Total 8 marks)

Q14. The bar chart shows how the UK's electricity demands in 2007 were met.



(a) What proportion of electricity was generated using renewable energy sources?

Show clearly how you work out your answer.

.....

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.....

.....

(2)

(b) By 2020, most of the UK's nuclear reactors and one-third of coal-fired power stations are due to close, yet the demand for electricity is expected to increase.

Four students, **A**, **B**, **C** and **D**, were asked how a demand of 380 billion kilowatt-hours could be met. They made the suggestions given in the table.

Student	Fossil fuels	Nuclear	Renewable	Bought from other countries
A	200	100	40	40
B	80	240	40	20
C	160	80	100	40
D	280	0	100	0

(i) Which student has made the suggestion most likely to result in the lowest carbon dioxide emissions?

.....

Give a reason for your answer.

.....

.....

(2)

(ii) Suggest **one** realistic way in which a householder could help to reduce the annual electricity demand.

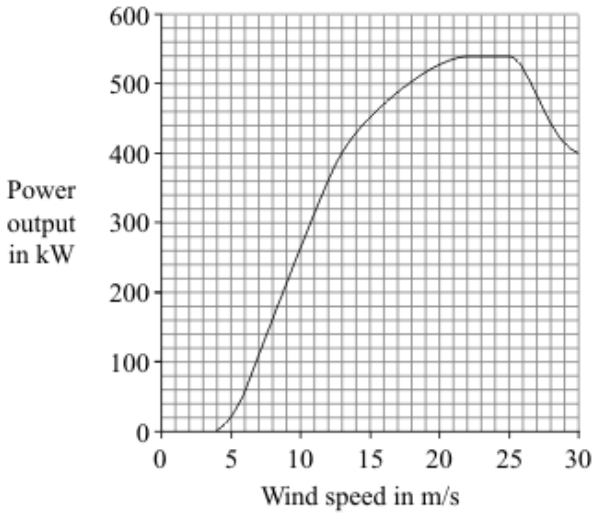
.....

.....

(1)

(c) To increase the amount of electricity generated using renewable energy resources would probably involve erecting many new wind turbines.

The graph shows the power curve of a wind turbine.



(i) Describe, in detail, how the power output of the turbine varies with the wind speed.

.....

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(3)

(ii) Give **one** disadvantage of using wind turbines to generate a high proportion of the electricity required in the UK.

.....

.....

(1)

(Total 9 marks)

Q15. (a) By 2023, nearly all of the existing nuclear power stations in the UK will be closed down.

(i) Before a nuclear power station can be demolished, the remaining nuclear fuel, radioactive waste materials and reactor must be carefully removed.

What is this process called?

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

decommissioning ☐

decontaminating ☐

dismantling ☐

(1)

(ii) The workers are exposed to radiation as they remove the reactor. One of the biggest risks is from the isotope cobalt-60, which has a half-life of 5.3 years.

Explain the advantage of waiting 11 years after a nuclear power station has closed down before starting to remove the reactor.

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(2)

(b) It is almost certain that new nuclear power stations will be built in the UK.

The table shows the results of surveys asking people in the UK whether they were in favour of, or against, the building of new nuclear power stations.

	2001	**2005**	**2007**
Percentage (%) in favour	20	41	65
Percentage (%) against	60	28	20
Percentage (%) not sure	20	31	15

(i) From these surveys, how did public opinion on the building of new nuclear power stations change between 2001 and 2007?

.....

.....

(1)

(ii) Suggest a reason why some people may think that the results from these surveys are unreliable.

.....

.....

(1)

(iii) Give **one** reason in favour of building new nuclear power stations.

.....

.....

(1)

(c) The government of one Middle Eastern country has decided to build its first nuclear power station. The oil that would have been used to generate electricity can then be sold to other countries.

On what is this decision based?

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

economic issues ☐

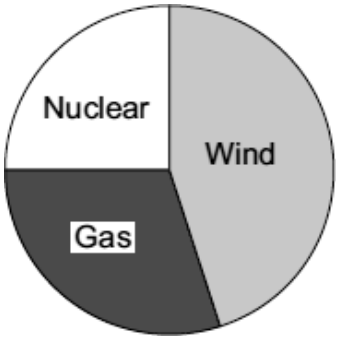
ethical issues ☐

social issues ☐

(1)
(Total 7 marks)

Q16. (a) An electricity company claims to generate all of its electricity from environmentally friendly energy sources.

The energy sources used by the company are shown in the pie chart.



Do you think that the claim made by the company is correct?

Draw a ring around your answer.

Yes **No** **Maybe**

Explain the reasons for your answer.

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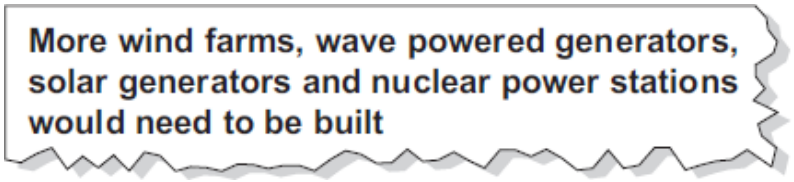
(2)

(b) The government is committed to increasing the amount of electricity generated from renewable sources. A newspaper reported that:



Why is the statement made in the newspaper incorrect?

.....

.....

(1)

(Total 3 marks)

Q17. A farmer has installed a biogas electricity generator on his farm. This device generates electricity by burning the methane gas produced from rotting animal waste. Methane is a greenhouse gas. When methane burns, carbon dioxide and water are produced.

The animal waste rots in an anaerobic digester. The digester and the generator are kept inside a farm building and cannot be seen from the outside.

(a) The animal waste used in the anaerobic digester is a *renewable* energy source.

What is meant by an energy source being *renewable*?

.....

.....

(1)

(b) Suggest **one** reason why farmers have been encouraged to install their own biogas generators.

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(1)

(c) The farmer's monthly electricity bill using the mains electricity supply was £300.
The biogas generator cost the farmer £18 000 to buy and install.

Assuming the biogas generator provides all of the farmer's electricity, what is the pay-back time for the generator?

.....

Pay-back time = ...

(1)

(d) It would have been cheaper for the farmer to have bought and installed a small wind turbine.

Give **two** advantages of using the biogas generator rather than a wind turbine, to generate the electricity used on the farm.

1 .....

.....

2 .....

.....

(2)
(Total 5 marks)

Q18. (a) Geothermal energy and the energy of falling water are two resources used to generate electricity.

(i) What is geothermal energy?

.....

.....

(1)

(ii) Hydroelectric systems generate electricity using the energy of falling water.

A pumped storage hydroelectric system can also be used as a way of storing energy for future use.

Explain how.

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(2)

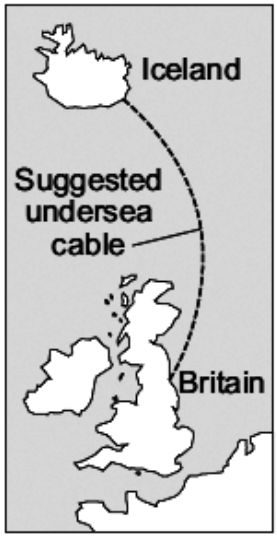
(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Read the following extract from a newspaper.

Britain may be switched on by Iceland

Iceland is the only country in the world generating all of its electricity from a combination of geothermal and hydroelectric power stations. However, Iceland is using only a small fraction of its energy resources. It is estimated that using only these resources, the amount of electricity generated could be increased by up to four times.

To help supply the future demand for electricity in Britain, there are plans to build thousands of new offshore wind turbines. It has also been suggested that the National Grid in Britain could be linked to the electricity generating systems in Iceland. This would involve laying a 700 mile undersea electricity cable between Iceland and Britain.



Discuss the advantages and disadvantages of the plan to build thousands of offshore wind turbines around Britain **and** the suggested electricity power link between Britain and Iceland.

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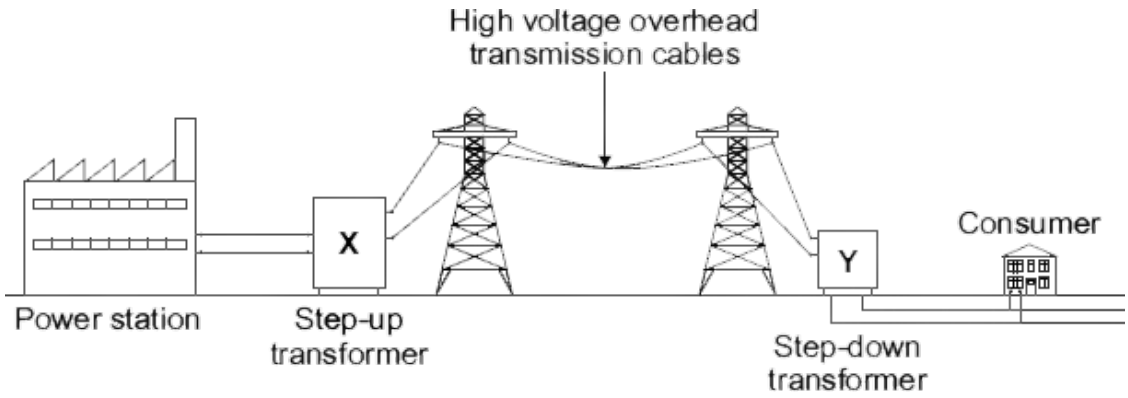
(6)
(Total 9 marks)

Q19. The diagram shows the National Grid system.



(a) The National Grid includes step-up transformers.

Explain why.

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(2)

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Over the next 10 years, more than 300 kilometres of new high voltage transmission cables are to be added to the National Grid. Most of the new cables will be suspended from pylons and run overhead while the rest will be buried underground.

Outline the advantages and disadvantages of both overhead transmission cables and underground transmission cables.

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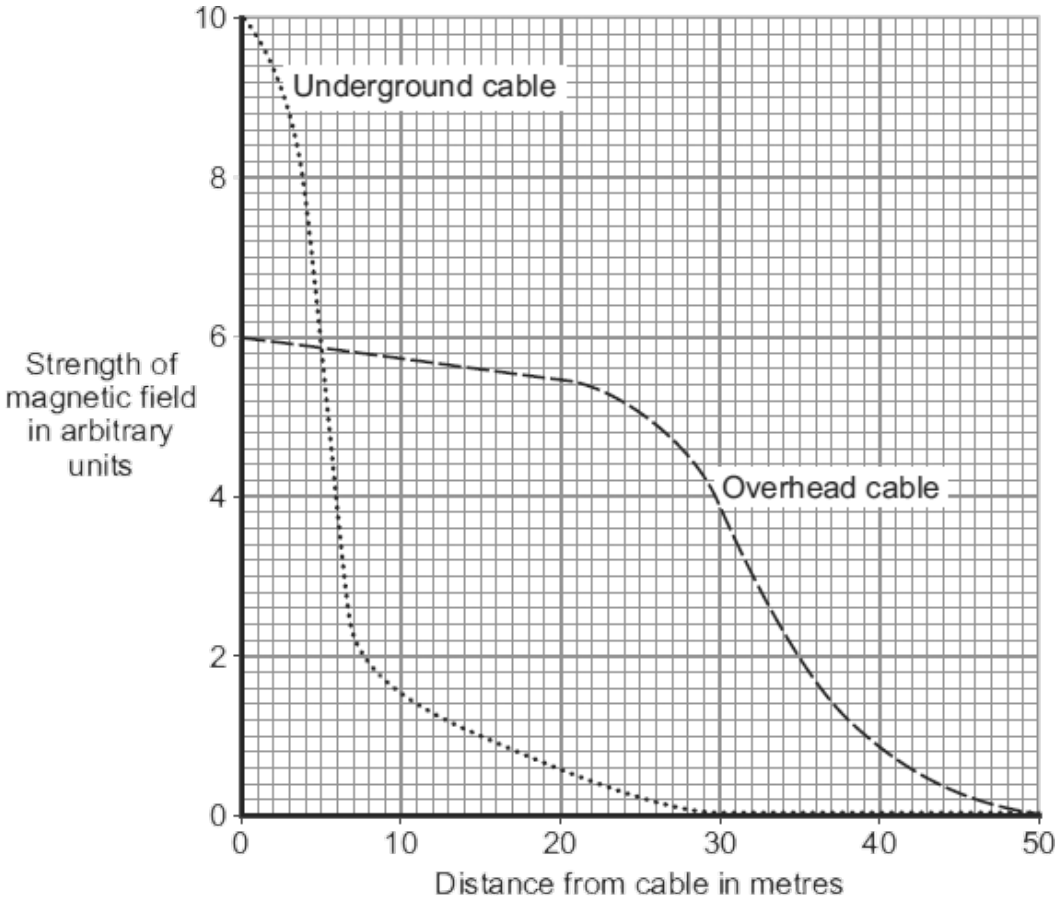
(6)

(c) When an electric current flows through a transmission cable, a magnetic field is produced.

The graph shows how the strength of the magnetic field varies with distance from both overhead and underground transmission cables that carry the same current.



What conclusions may be drawn from this graph?

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(2)

(d) Some people think that, because of the magnetic fields, living close to transmission cables is dangerous to health. Laboratory studies on mice and rats exposed to magnetic fields for two or more years found that the magnetic fields had no effect on the animals' health.

Draw a ring around the correct answer in the box to complete the sentence.

Using animals in scientific research raises

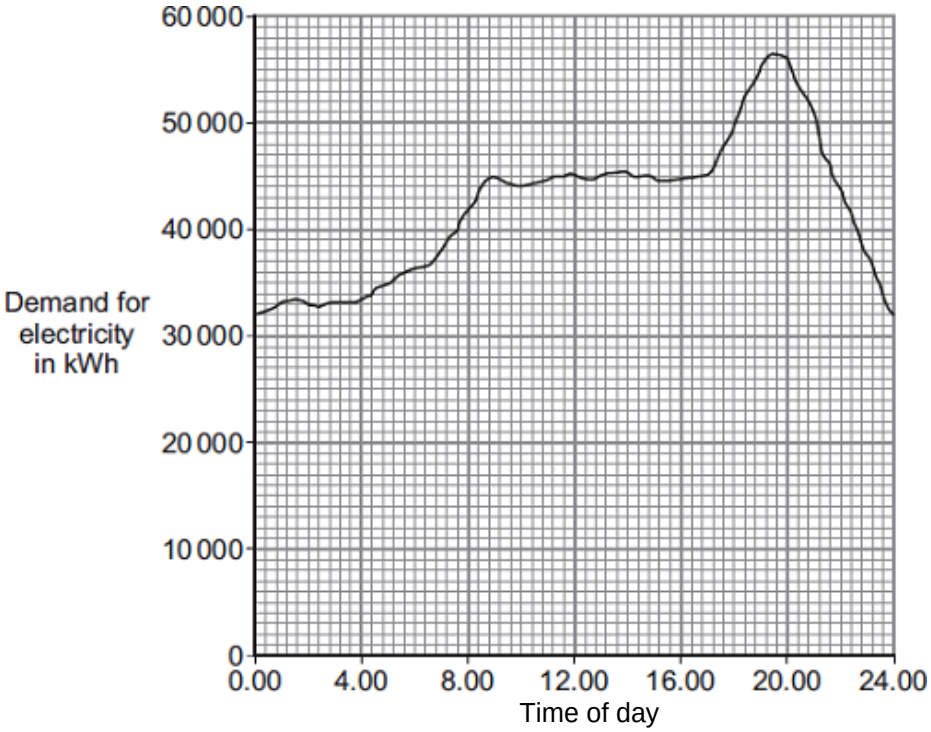
economic
environmental
ethical

issues.

(1)

(Total 11 marks)

Q20. (a) The graph shows how the demand for electricity in the UK changes during one 24-hour period.



The table gives the start-up times for two types of power station.

Type of power station	Start-up time
Gas	A few minutes
Nuclear	Several days

How would these two types of power station be used to meet the demand for electricity during this 24-hour period?

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.....

(3)

(b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate*.

A farmer plans to generate all the electricity needed on her farm, using either a biogas generator or a small wind turbine.

The biogas generator would burn methane gas. The methane gas would come from rotting the animal waste produced on the farm. When burnt, methane produces carbon dioxide.

The biogas generator would cost £18 000 to buy and install. The wind turbine would cost £25 000 to buy and install.

The average power output from the wind turbine would be the same as the continuous output from the biogas generator.

Evaluate the advantages and disadvantages of the two methods of generating electricity.

Conclude, with a reason, which system would be better for the farmer to buy and install.

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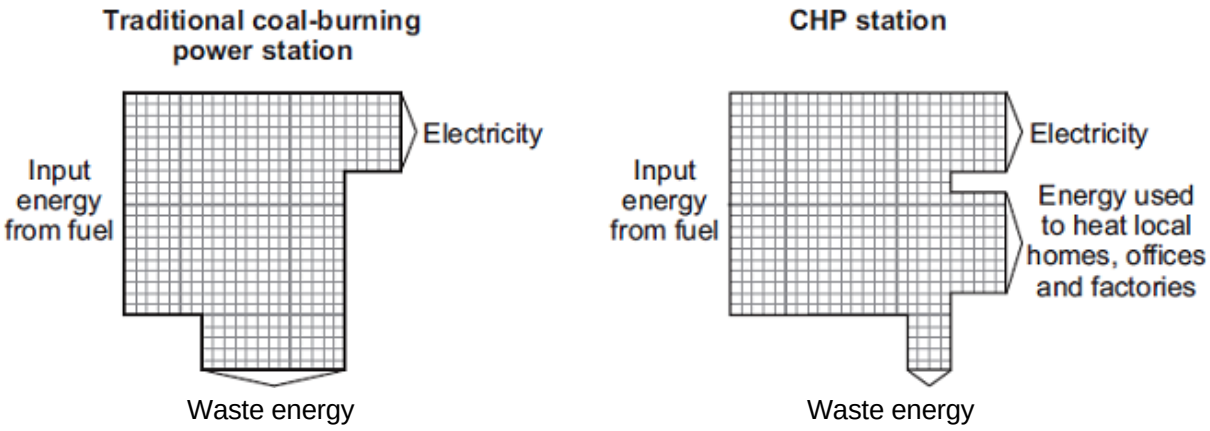
(6)
(Total 9 marks)

Q21. The Sankey diagrams show the energy transfers in a traditional coal-burning power station and a combined heat and power (CHP) station.



(a) What effect does the waste energy from a power station have on the surroundings?

.....

.....

(1)

(b) Calculate the efficiency of the CHP station.

Use the correct equation from the Physics Equations Sheet.

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Efficiency = ...

(2)

(c) Why is a CHP station more efficient than a traditional coal-burning power station?

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.....

(2)

(d) A CHP station is usually used to meet the demand for electricity within the local area. The electricity is not transmitted and distributed through the National Grid.

(i) What is the National Grid?

Tick (✓) **one** box.

A system of cables and pylons. ☐

A system of cables and transformers. ☐

A system of cables, transformers and power stations ☐

(1)

(ii) Using the electricity locally and not transmitting it through the National Grid increases the overall efficiency of a CHP station by 7%.

Give **one** reason why.

.....

.....

(1)
(Total 7 marks)