



Exampro GCSE Physics

P1 Foundation - Generating Electricity Self Study Questions

Name:

Class:

Author:

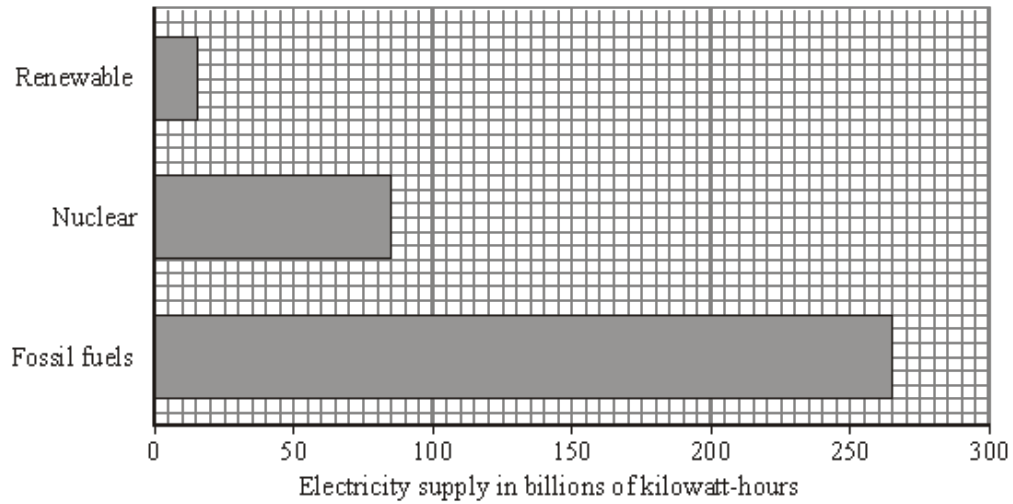
Date:

Time: 78

Marks: 78

Comments:

Q1. The bar chart shows the different energy sources used to generate the UK's electricity in 2007.



(a) (i) The wind is a renewable energy source.

Name **one** more renewable energy source used to generate electricity.

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(1)

(ii) Complete the following sentence by drawing a ring around the correct line in the box.

Using less fossil fuels to generate electricity will

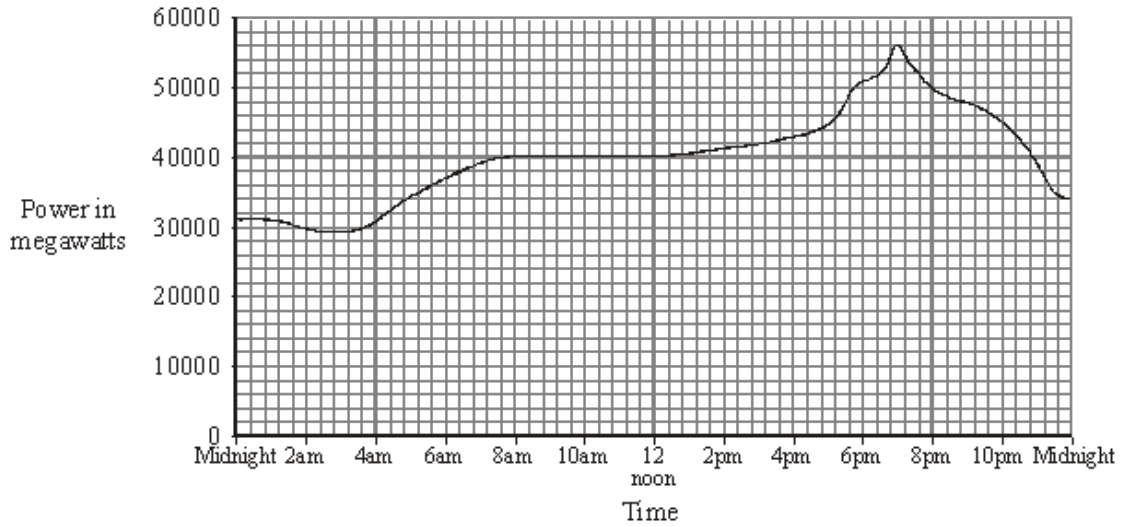
decrease
not change
increase

the

amount of carbon dioxide emitted into the atmosphere.

(1)

- (b) The graph shows how the demand for electricity in the UK varied over one day in the winter.



- (i) Describe how the demand for electricity varied between 4.00 am and 10.00 am.

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(2)

- (ii) Which type of power station has the fastest start-up time?

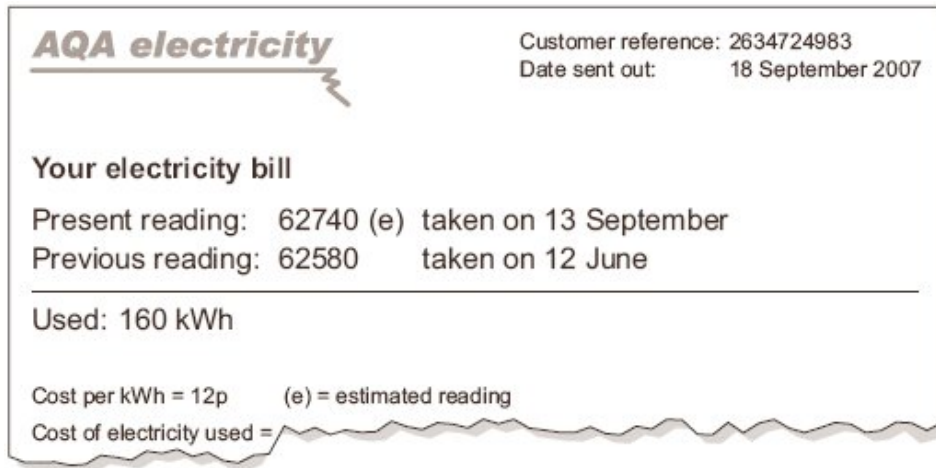
Draw a ring around your answer.

coal natural gas nuclear oil

(1)

(Total 5 marks)

- Q2.** A householder was out shopping when her electricity meter reading should have been taken. The electricity company estimated the reading and sent the following bill. Unfortunately, the bill was damaged in the post.



- (a) Use the equation in the box to calculate the cost of the electricity used between 12 June and 13 September.

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

Show clearly how you work out your answer.

.....

Total cost =

(2)

- (b) The estimated reading shown on the bill was not very accurate. The correct reading was 62920.

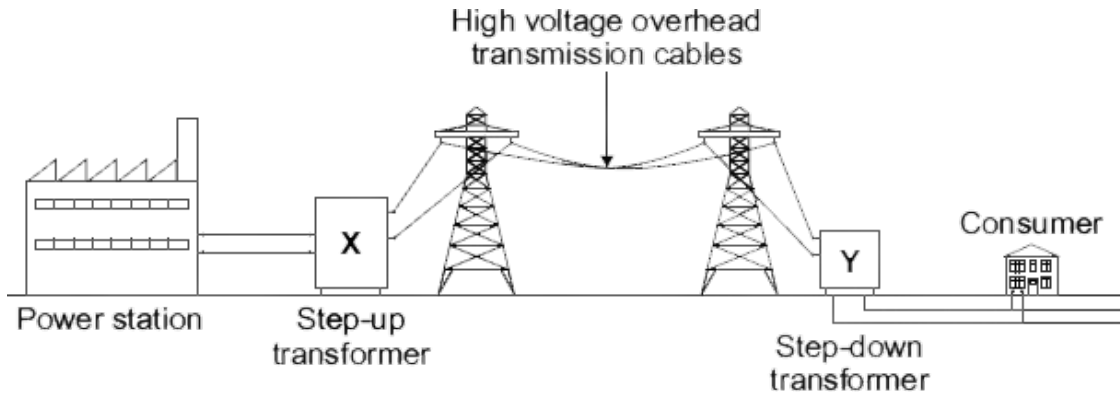
How many kilowatt-hours of electricity had the householder actually used between 12 June and 13 September?

.....

(2)

(Total 4 marks)

Q3. 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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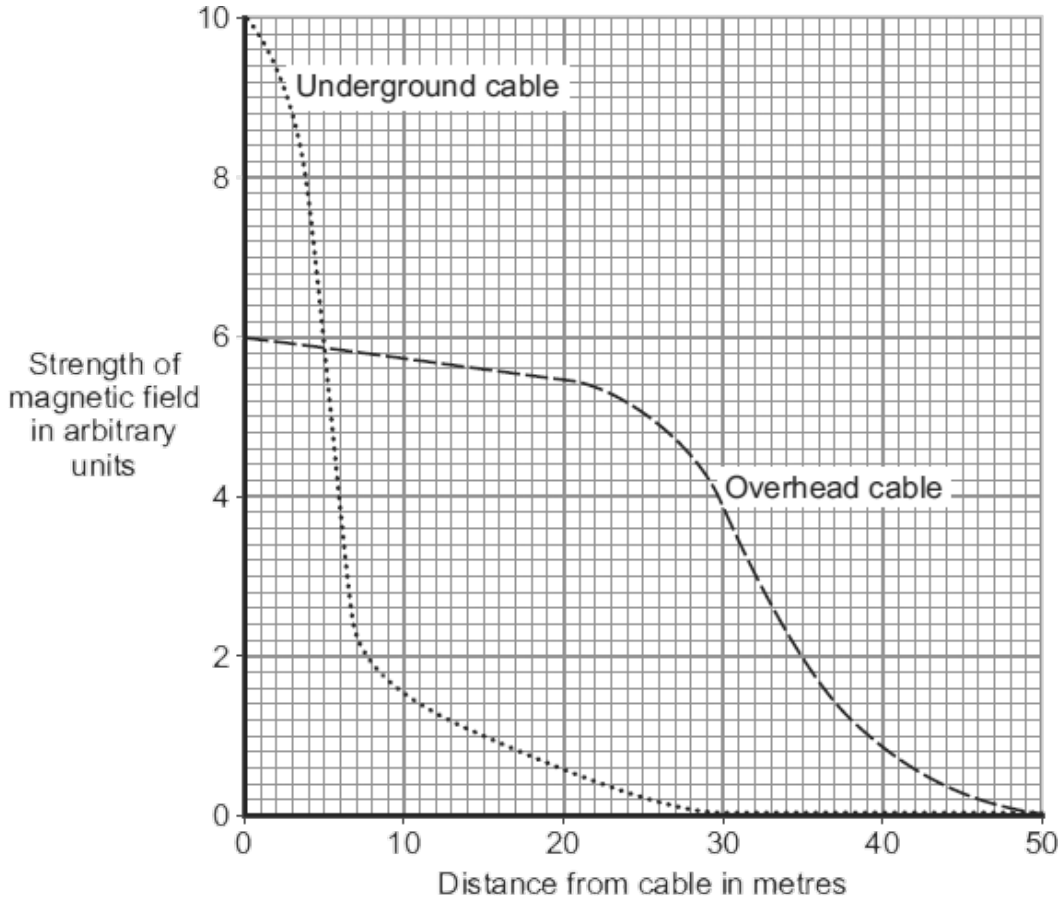
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(6)

(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)

Q4. Iceland is a country that generates most of its electricity using geothermal power stations and hydroelectric power stations.

- (a) (i) Complete the following sentences to describe how some geothermal power stations work.

In regions where volcanoes are active, the ground is hot.

Cold is pumped down into the ground

and is by hot rocks.

It returns to the surface as steam. The steam is used to turn a turbine.

The turbine drives a to produce electricity.

(3)

- (ii) Which **one** of the following statements about geothermal power stations is true?

Tick (✓) **one** box.

Geothermal power stations use fossil fuels.

Geothermal power stations produce carbon dioxide.

Geothermal power stations provide a reliable source of electricity.

(1)

(b) What is needed for a hydroelectric power station to be able to generate electricity?

Tick (✓) **one** box.

Falling water

A long coastline

Lots of sunny days

(1)
(Total 5 marks)

Q5. (a) Geothermal energy and the energy of falling water are two resources used to generate electricity.

(i) What is geothermal energy?

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.....

(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)

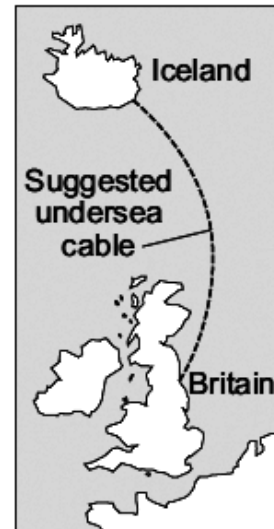
- (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

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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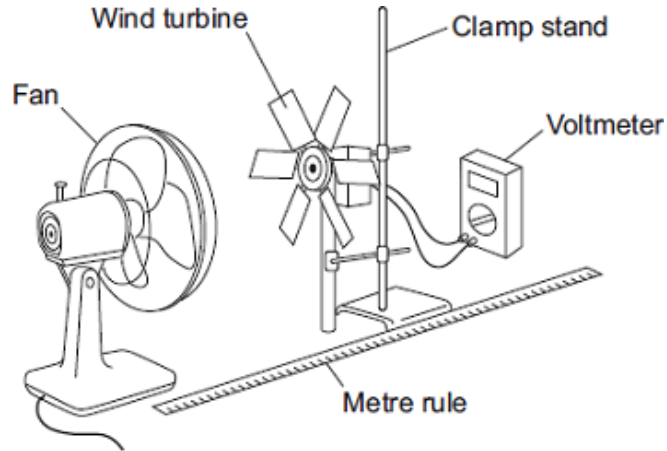
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(6)
(Total 9 marks)

- Q6.** (a) A student investigated how the number of blades on a wind turbine affects the output voltage of the turbine.

The student used the apparatus shown in the diagram.



The fan was used to turn the wind turbine.

- (i) The fan was always the same distance from the wind turbine.

Why?

.....
.....

(1)

- (ii) After switching the fan on, the student waited 20 seconds before taking the voltmeter reading.

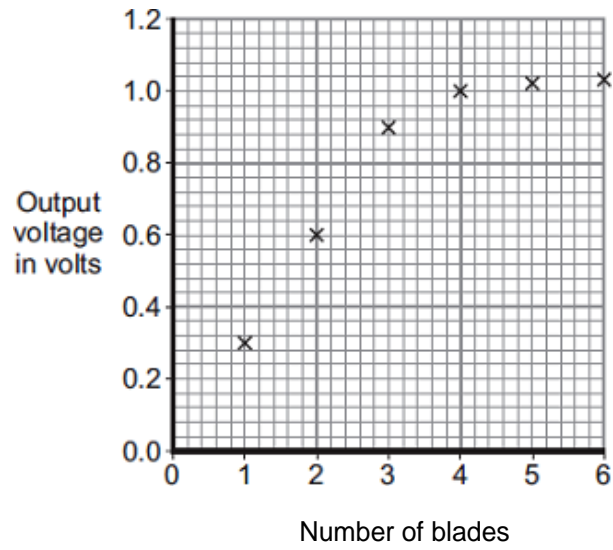
Suggest why.

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(1)

(iii) The student changed the number of blades on the wind turbine.

The student's results are shown in the scatter graph.



What conclusion can be made from the results in the scatter graph?

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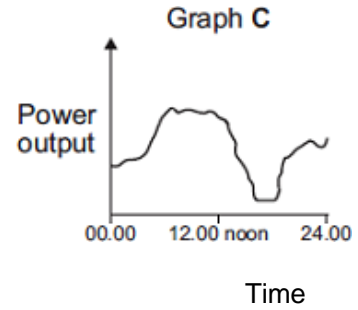
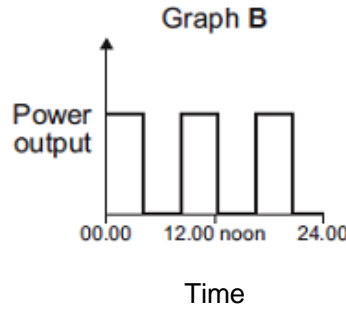
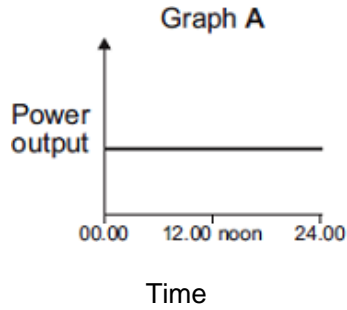
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(2)

(b) The amount of electricity generated using wind turbines is increasing.

Which graph, **A**, **B** or **C**, is most likely to show the electrical power output from a wind turbine over one day?



Write the correct answer, **A**, **B** or **C**, in the box.

Give a reason for your answer.

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(2)
(Total 6 marks)

Q7. 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?

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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

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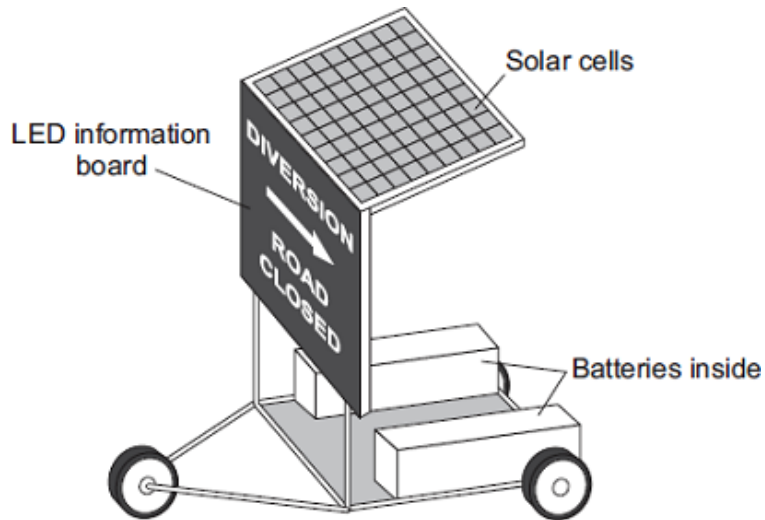
2

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(2)

(Total 5 marks)

Q8. The picture shows a temporary road traffic information board.



The batteries power the LEDs used in the information board.
The solar cells keep the batteries charged.

(a) Use words from the box to complete each of the following sentences.

chemical	electrical	light	sound
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The solar cells transfer light energy to energy.

The batteries transfer energy to electrical energy.

The LEDs transfer electrical energy to energy.

(3)

(b) When the total energy input to the solar cells is 200 joules, the useful energy output from the solar cells to the batteries is 50 joules.

Calculate the efficiency of the solar cells.

Use the correct equation from the Physics Equations Sheet.

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.....

Efficiency =

(2)

(c) Which **one** of the following statements gives the reason for using solar cells to charge the batteries?

Tick (✓) **one** box.

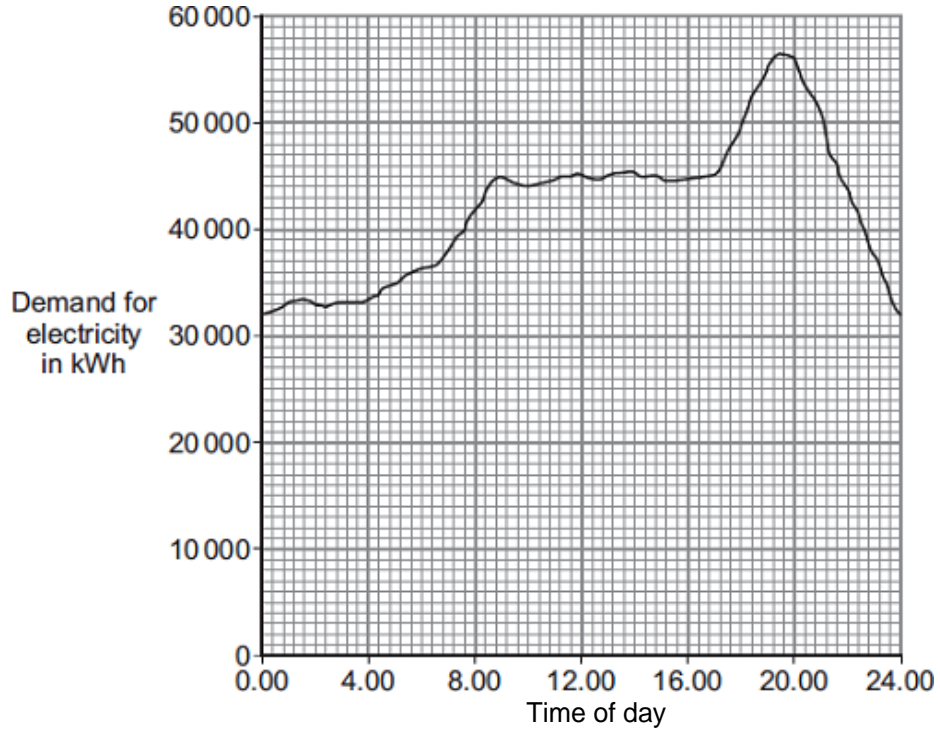
Solar cells will charge the batteries day and night.

The information board can be used anywhere it is needed.

A small number of solar cells produce a lot of electricity.

(1)
(Total 6 marks)

- Q9.** (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)

Q10. Electricity is generated in power stations. It is then sent to all parts of the country through a network of cables.

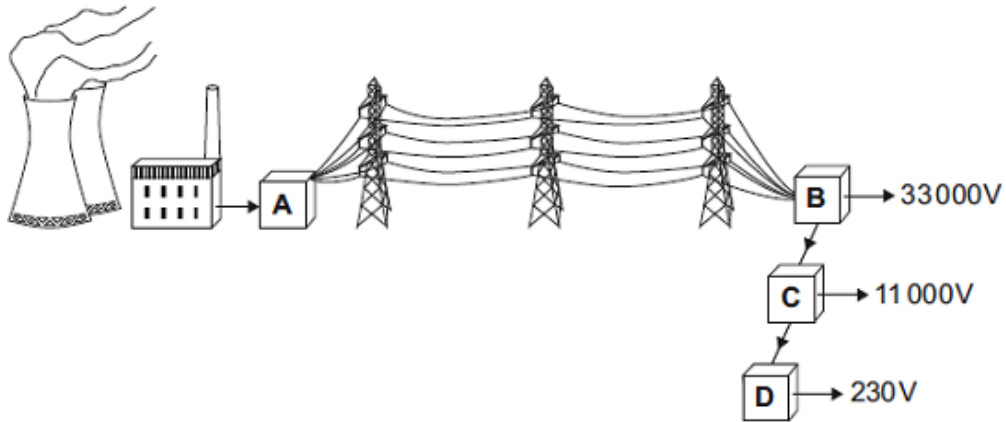
- (a) Complete the following sentence by using **one** of the words in the box.

Grid	Power	Supply
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The network is called the National

(1)

(b) In the diagram, **A**, **B**, **C** and **D** are transformers.



(i) Which transformer, **A**, **B**, **C** or **D**, is a step-up transformer?

Transformer

(1)

(ii) Which transformer, **A**, **B**, **C** or **D** will supply homes, offices and shops?

Transformer

(1)

(c) Complete the following sentence by drawing a ring around the correct line in the box.

In a step-up transformer, the potential difference (p.d.) across the

primary coil is

less than
the same as
more than

 the p.d. across the secondary coil.

(1)

(Total 4 marks)

Q11.

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

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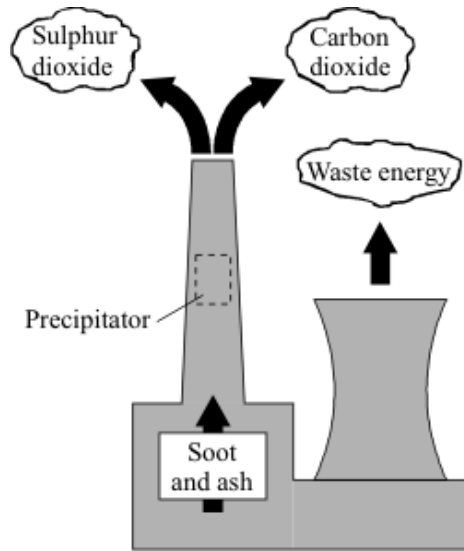
(2)

(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)

Q12. Four students are talking about the different energy sources used to generate electricity in the areas where they live.

- (a) Draw **one** line from where each student lives (**List A**) to the energy source in their area (**List B**).

Draw only **four** lines.

List A Where each student lives	List B Energy source
Where I live is the sunniest part of the country.	Wind
Where I live, the land is very flat and it always seems to be windy.	Waves
Where I live, it is not safe to swim. The sea is always too rough.	Solar
Where I live, you can see steam coming out of the ground.	Tides
	Geothermal

(4)

- (b) All of the energy sources given in part (a) can be used to generate electricity.

What else do all these energy sources have in common?

.....
.....

(1)

- (c) In a hydroelectric power station, the energy from falling water is used to generate electricity.

Which **one** of the following gives a **disadvantage** of a hydroelectric power station?

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

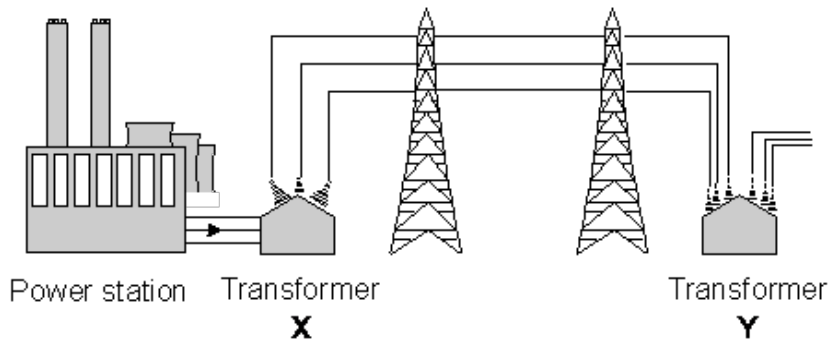
has a fast start-up time

large areas of land are flooded

polluting gases are produced

(1)
(Total 6 marks)

- Q13.** 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)

- M1.** (a) (i) any **one** from:
- waves
*do **not** accept water*
 - tides
 - falling water
accept hydroelectric
 - biofuel / biomass
 - solar
accept sun / sunlight
*do **not** accept light*
accept solar cells / panels
 - geothermal
*do **not** accept heat*
- 1
- (ii) decrease
- 1
- (b) (i) increases from 4am (to 8am) remains constant from 8am (to 10am)
accept increases from 30 000
accept stays constant from 40 000
allow 1 mark for goes up then stays the same
for full credit must be some indication of time or power
- 2
- (ii) natural gas
- 1

[5]

- M2.** (a) £19.20
- allow 1 mark for correct substitution*
ie 160 x 12
allow 1 mark for an answer (£)1920
*an answer of 1920p gains **both** marks*
*an answer of £40.80 gains **both** marks*
allow 1 mark for 340 x 12
- 2

(b) 340

*allow 1 mark for correctly using the reading 62580
ie 62920 – 62580
accept £40.80 for **both** marks*

2

[4]

M3. (a) increases the voltage (across the cables)
or
decreases the current (through the cables)

1

reducing energy losses (in cables)
*accept heat for energy
do **not** accept electricity for energy
do **not** accept no energy loss
accept wires do not get as hot*

or
increases efficiency of (electricity / energy) transmission
ignore reference to travel faster

1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the Marking Guidance, and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1-2 marks)

There is a brief description of one advantage or disadvantage of using either overhead or underground cables.

Level 2 (3-4 marks)

There is a description of some of the advantages **and / or** disadvantages for both overhead and underground cables, with a minimum of three points made. There must be at least **one** point for each type of cable.

Level 3 (5-6 marks)

There is a clear and detailed description of the advantages and disadvantages of overhead **and** underground cables, with a minimum of five points made. At least one advantage and one disadvantage for each type of cable.

examples of the points made in the response

marks may be gained by linking an advantage for one type of cable with a disadvantage for the other type of cable

eg

overhead cables are easy to repair = 1 mark

overhead cables are easier to repair = 1 mark

overhead cables are easier to repair than underground cables = 2 marks

Overhead
Advantages

- (relatively) quick / easy to repair / maintain / access
easy to install is insufficient
*do **not** accept easy to spot / see a fault*
- less expensive to install / repair / maintain
less expensive is insufficient
- cables cooled by the air
accept thermal energy / heat removed by the air
- air acts as electrical insulator
accept there is no need for electrical insulation (around the cables)
- can use thinner cables
difficult to reach is insufficient
land beneath cables can still be used is insufficient

Disadvantages

- spoil the landscape
- greater risk of (fatal) electric shock
- damaged / affected by (severe) weather

*accept specific examples eg high winds, ice
more maintenance is insufficient*

- hazard to low flying aircraft / helicopters
*kites / fishing lines can touch them is insufficient
hazard to aircraft is insufficient*

Underground Advantages

- cannot be seen
- no hazard to aircraft / helicopters
- unlikely to be / not damaged / affected by (severe) weather
less maintenance is insufficient

(normally) no / reduced shock hazard
installed in urban areas is insufficient

Disadvantages

- repairs take longer / are more expensive
*accept harder to repair / maintain
have to dig up for repairs is insufficient*
- (more) difficult to access (cables)
*hard to locate (cables) is insufficient
faults hard to find is insufficient*
- (very) expensive to install
- thicker cables required
- need cooling systems
- need layers of electrical insulation
- land disruption (to lay cables)
accept damage to environment / habitat(s)
or
cannot use land either side of cable path
accept restricted land use

(c) examples of acceptable responses:

allow 1 mark for each correct point

- closest to cables field from underground is stronger
- field from overhead cables stronger after 5 metres
- field from underground cables drops rapidly
- field from overhead cables does not drop much until after 20 metres
accept values between 20 and 30 inclusive
- overhead field drops to zero at / after 50 metres
- underground field drops to zero at / after 30 metres
- (strength of) field decreases with distance for both types of cable
if suitably amplified this may score both marks

2

(d) ethical

1

[11]

M4. (a) (i) water

1

heated

accept boiled or turned to steam

*do **not** accept evaporated*

1

generator

1

(ii) geothermal power stations provide a reliable source of electricity

1

(b) falling water

1

[5]

M5. (a) (i) energy from hot rocks in the Earth

accept heat that occurs naturally in the Earth

accept steam / hot water rising to the Earth's surface

accept an answer in terms of the energy released by radioactive decay in the Earth

heat energy is insufficient

1

(ii) water is pumped / moved

1

up (to a higher reservoir)

this mark point only scores if first mark point is awarded

1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the Marking Guidance and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1-2 marks)

There is a brief description of at least one advantage or disadvantage for either the planned wind turbines or the suggested electricity power link.

Level 2 (3-4 marks)

There is a description of advantages and disadvantages for either the planned wind turbines or the suggested electricity power link.

or

A description of the advantages or disadvantages for both the planned wind turbines and the suggested electricity power link.

Level 3 (5-6 marks)

There is a clear and detailed description of at least one advantage and one disadvantage for both the planned wind turbines and suggested electricity power link.

examples of the points made in the response

Offshore wind turbines

advantages

- renewable (energy resource)
- low running costs
- energy is free
- no gas emissions (when in use)
accept a named gas eg CO₂
accept no fuel is burned
accept less dependent on fossil fuels
- land is not used (up)

disadvantages

- unreliable – accept wind does not always blow
ignore references to destroying or harming habitats
- hazard to birds / bats
- visual pollution – do not accept noise pollution
*do **not** allow if clearly referring to onshore wind turbines*
*do **not** accept spoils landscape*
- difficulty of linking turbines to the National Grid
- large initial cost
- difficult to erect / maintain
accept a lot of maintenance needed
- CO₂ emissions in manufacture (of large number of turbines)

Suggested Link

advantages

- income for Iceland
- using Iceland's (available) energy (resources)
accept using (Iceland's) renewable energy (resources)
*do **not** accept reduce the amount of Iceland's wasted energy*
- provide electricity when wind does not blow / reliable
- provide electricity at times of peak demand
- even out fluctuations in supply
- excess electricity from Britain (windy days) to Iceland and used to pump water up to store energy
- Britain less dependent on fossil fuels
accept Britain needs fewer (new) power stations
accept conserves fossil fuels

disadvantages

- large initial cost
accept expensive (to lay cables)
- power loss along a long cable
- (engineering) difficulties in laying / maintaining the cable
accept difficult to repair (if damaged)

M6. (a) (i) changing the distance may / will affect / change the voltmeter reading
accept so only one independent variable
accept distance affects speed of wind (turbine)
accept it is a control variable
accept to give valid results
fair test is insufficient
to make the results accurate is insufficient 1

(ii) any sensible practical suggestions, eg

- so fan reaches a steady / full speed
accept power for speed
- so wind (turbine) reaches a steady / full speed
- so voltmeter reaches / gives a steady reading
accept accurate or valid reading a correct reading is insufficient
*do **not** accept precise reading*

1

(iii) as the number of blades increases so does the (voltmeter) reading / output / voltage
number of blades affects the reading / output is insufficient 1

further relevant detail, eg

- voltmeter increase is greatest up to 3 blades
 - voltmeter reading hardly changes with 4, 5 or 6 blades
accept does not change between 4 and 6 blades
 - increase is directly proportional up to 3 blades
 - it reaches a limit
accept does not change after 4 / 5 blades
 - a numerical example giving two pairs of numbers, eg 2 blades = 0.6V, 4 blades = 1V
- 1

(b) C
reason scores only if C is chosen 1

wind speed / strength varies
*accept wind is **not** constant / reliable* 1

[6]

M7. (a) can be replaced as fast / faster than it is used
accept will not run out
can be used again negates this mark 1

(b) any **one** from:

- reduce demand on power stations / National Grid (system)
- to increase the amount of electricity generated (from renewable energy)
- to conserve fossil fuels
accept use less fossil fuels
- plenty of animal waste / fuel (available)
accept so animal waste can be used usefully
accept to save money / sell the electricity
produces less harmful gases / SO₂ is insufficient
better for environment is insufficient

1

(c) 60 (months) / 5 (years)

ignore any unit given

1

(d) *answers must be in terms of the biogas generator*

any **two** from:

- reliable energy source
or
does not depend on the weather
accept works all of the time
- uses up waste products
accept animal waste readily available
- not visually polluting
- concentrated energy source
- quieter
ignore it is renewable
*do **not** accept generates more electricity (than wind turbine)*

2

[5]

M8. (a) electrical

1

chemical

1

light

1

(b) 25% **or** 0.25

allow 1 mark for correct substitution, ie $50 \div 200$ provided no subsequent step shown

or

*answers of 25 with a unit **or** 0.25 with a unit gain 1 mark*

*answers of 25 without a unit **or** 0.25% gain 1 mark*

2

(c) the information board can be used anywhere it is needed

1

[6]

M9. (a) any **three** from:

- gas can be switched on (and off) quickly but nuclear cannot
gas has a short start-up time alone is insufficient
 - gas can be used to meet surges in demand
accept specific times from graph, anything from 1700 to 2200
 - gas can contribute to / meet the base load
 - nuclear provides base load
- or**
- nuclear is used to generate all of the time

3

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#), and apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)

There is a brief description of one advantage **or** disadvantage of using either biogas or wind

or

makes a conclusion with a reason.

Level 2 (3-4 marks)

There is a description of some advantages **and / or** disadvantages for biogas **and / or** wind

or

there is a direct comparison between the two systems **and** at least one advantage / disadvantage

or

a detailed evaluation of one system only with a conclusion.

Level 3 (5-6 marks)

There is a clear and detailed comparison of the two systems.

There must be a clear conclusion of which system would be best with at least one comparative reason given for the choice made.

Examples of the points made in the response

extra information

Biogas

- renewable
- energy resource is free
- reliable energy source
accept works all of the time
- does not depend on the weather
- uses up (animal) waste products
- concentrated energy source
- cheaper (to buy and install)
accept once only
- shorter payback-time (than wind)
- adds carbon dioxide to the atmosphere
when waste burns it produces carbon dioxide is insufficient
- contributes to the greenhouse effect
or
contributes to global warming
- no transport cost for fuels

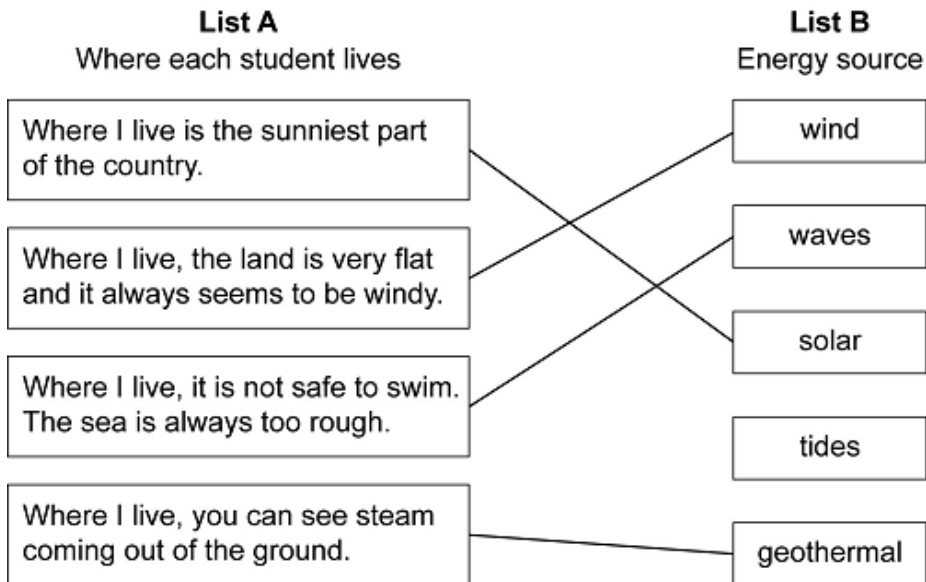
Wind turbine

- renewable
- energy resource is free
- not reliable
- depends on the weather / wind
- will be times when not enough electricity generated for the farm's needs
- dilute energy source
- longer payback-time (than biogas)
- more expensive (to buy and install)
accept once only
- does not produce any carbon dioxide
accept does not pollute air
accept pollutant gases for carbon dioxide
produces visual or noise pollution is insufficient
harmful gases is insufficient

- M10.** (a) grid
accept any unambiguous indication 1
- (b) (i) A (only) 1
- (ii) D (only) 1
- (c) less than 1
- [4]**

- M11.** (a) (i) photosynthesis for growth
accept plants require sunlight for growth 1
- plants change into coal
any mention of animals negates second mark 1
- (ii) burning
*do **not** accept heating*
accept combustion 1
- (b) (i) heat 1
- (ii) less heat radiated into space
accept increased insulation round earth
accept reflects heat back to earth
accept greenhouse effect
*accept traps heat **or** energy* 1
- [5]**

M12. (a) all 4 lines correct



*allow 1 mark for each correct line
if more than 1 line goes from a box in **List A** then all those lines are incorrect*

4

(b) all renewable

*accept a correct description of renewable
eg replaced faster than used **or** never run out
do **not** accept can be used again
accept any other common feature
eg do not produce pollution /
polluting (gases)
no fuel is burnt
(energy input) is free
eco-friendly / environmentally friendly / natural resources /
sustainable sources are insufficient*

1

(c) large areas of land are flooded

1

[6]

M13. (i) reduces

for 1 mark

1

(ii) less heat/energy/power wasted (in power lines)

for 1 mark

1

(iii) for safety

for 1 mark

1

[3]

