AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.2.4 ENERGY TRANSFERS (PACK 3)

SCORE	PERCENTAGE
/182	%

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Q1.

Figure 1 shows a mobile phone being recharged by a portable power source.

Figure 1



(a) Why does the battery in the phone need recharging?

Tick **one** box.

The store of chemical energy in the battery has reduced.	☐
The store of thermal energy in the battery has reduced.	☐
The store of kinetic energy in the battery has reduced.	☐
The store of gravitational energy in the battery has reduced.	☐

(1)

(b) The power source provides a current of 1.86 A at a potential difference of 3.90 V

Calculate the power of the power source.

Use the equation:

power = potential difference × current

Choose the correct unit from the box.

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C	J	W

Power = _____

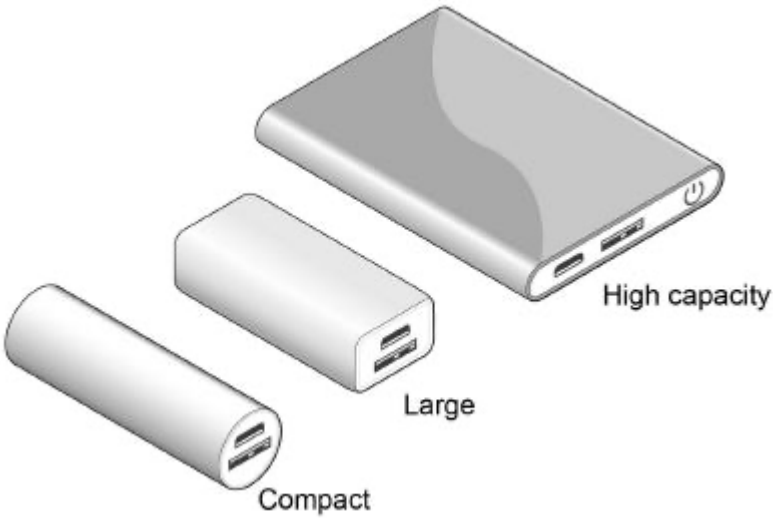
Unit _____

(3)

(c) A student needs a new power source.

Figure 2 shows three different sized power sources.

Figure 2



The table below gives data about the different power sources.

Power source	Number of charges	Mass in grams
Compact	1	100
Large	5	200
High capacity	10	600

The student chose the large power source.

Suggest why the student chose the large power source.

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_____

_____

_____

(4)

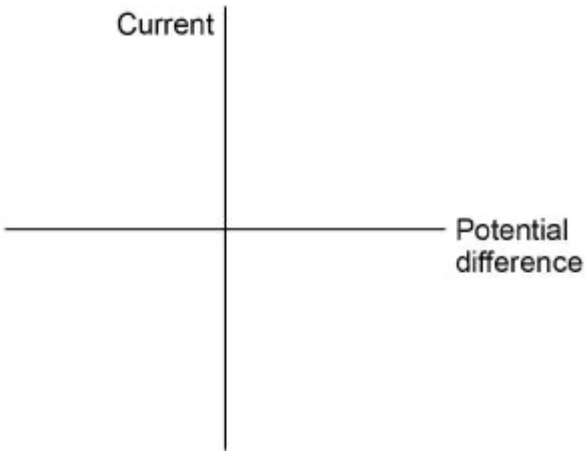
(Total 8 marks)

Q2.

A student built a circuit using filament lamps.

(a) Sketch a current potential difference graph for a filament lamp on **Figure 1**

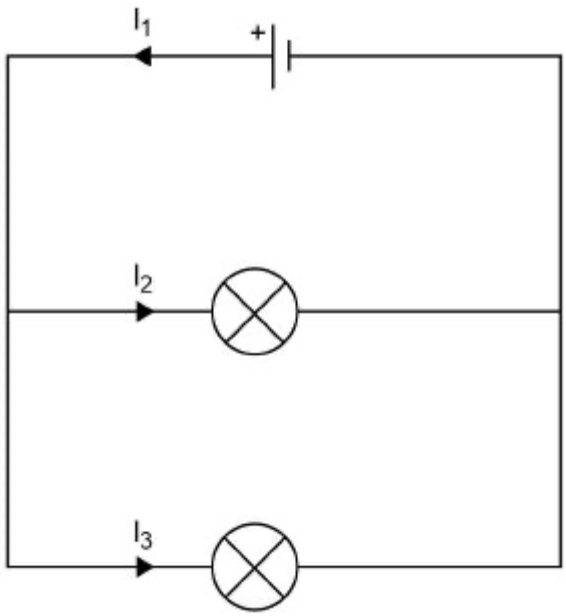
Figure 1



(2)

Figure 2 shows the circuit with two identical filament lamps.

Figure 2



(b) Compare the currents I_1, I_2 and I_3

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_____

_____

_____

(2)

(c) Calculate the charge that flows through the cell in 1 minute.

Each filament lamp has a power of 3 W and a resistance of 12 Ω

Write any equations that you use.

Give the unit.

_____

_____

_____

_____

_____

_____

Charge = _____

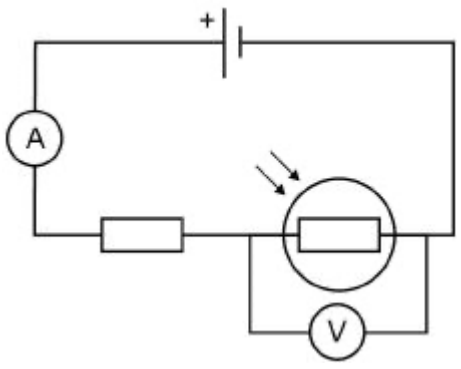
Unit = _____

(6)

(d) The student builds a different circuit.

Figure 3 shows the circuit.

Figure 3



Explain how the readings on both meters change when the environmental conditions change.

_____

_____

_____

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(6)

(Total 16 marks)

Q3.

An energy input of 1.3×10^{18} J is supplied each year by power stations to the National Grid.

Not all of this energy is supplied to consumers. Some of the energy is wasted in the distribution process.

(a) Write the equation which links efficiency, total input energy transfer and useful output energy transfer.

(1)

(b) The energy supplied each year to consumers is 1.2×10^{18} J

Calculate the efficiency of the distribution process.

Efficiency = _____

(2)

(c) How is electrical power transmitted across the National Grid to make the process as efficient as possible?

Tick **one** box.

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At a high potential difference and a high current ☐

At a high potential difference and a low current ☐

At a low potential difference and a high current ☐

At a low potential difference and a low current ☐

(1)

(d) Write the equation which links energy transferred, power and time.

_____

_____

(1)

(e) A wind turbine supplies a power output of 8000 kW for 1200 seconds.

Calculate the energy transferred by the wind turbine in kJ

_____

_____

_____

_____

_____

Energy transferred = _____ kJ

(3)

(f) Describe the environmental advantages and disadvantages of using wind turbines to generate electricity in the UK.

_____

_____

_____

_____

_____

_____

_____

_____

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_____

_____

(4)

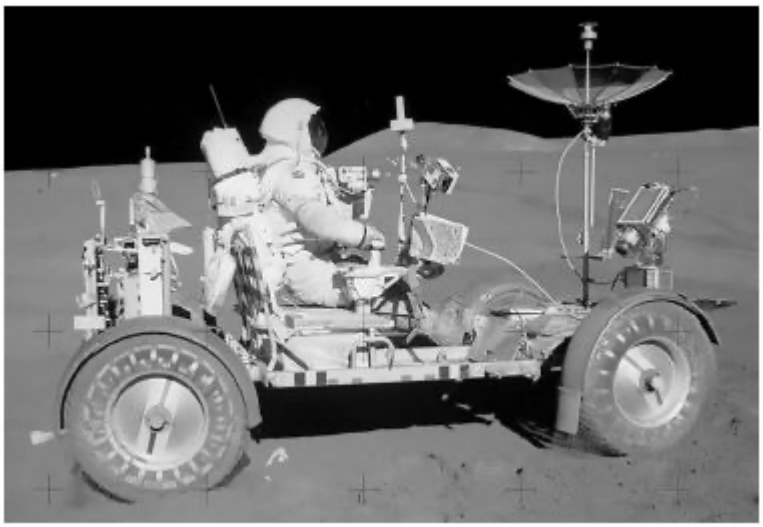
(Total 12 marks)

Q4.

Astronauts have been to the Moon.

(a) Astronauts moved around the surface of the Moon in a lunar rover.

The photograph below shows a lunar rover.



The batteries on the lunar rover provided a potential difference of 36 V

The total charge stored in the batteries was 870 000 C

Calculate the maximum energy that could have been transferred from the batteries.

Use the equation:

energy transferred = charge flow × potential difference

_____

_____

_____

_____

Maximum energy transferred = _____ J

(2)

(b) Not all of the energy from the batteries was usefully transferred to the kinetic energy of the lunar rover.

Explain why.

_____

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_____

_____

_____

(2)

The astronauts collected rock samples from the Moon.

Scientists analysed the percentages of elements in Moon rock and Earth rock.

The table below shows the results.

Element	**Percentage in Moon rock**	**Percentage in Earth rock**
Aluminium	8	8
Iron	13	5
Oxygen	42	47
Silicon	**X**	28
Other elements	10	12

(c) Calculate value **X** in the table above.

X = _____ %

(1)

(d) Give **one** similarity and **one** difference between Moon rock and Earth rock.

Use the table above.

Similarity _____

_____

Difference _____

_____

(2)

(e) Scientists used to think the Earth and Moon formed separately.

Scientists now believe that the Moon formed after a collision between the Earth and a small planet.

This new idea came from the study of Moon rocks.

Why do scientific theories sometimes change?

Tick **one** box.

Scientists agree that the existing theory is old-fashioned ☐

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Scientists change their theories to make the theories more popular ☐

Scientists decide that the new theory is more exciting ☐

Scientists discover new evidence which the existing theory cannot explain ☐

(1)

(f) Write down the equation which links gravitational field strength, gravitational potential energy, height and mass.

_____

_____

(1)

(g) When the astronauts left the Moon, they used a spacecraft with a mass of 2150 kg

Calculate the height reached by the spacecraft at the point where it had a gravitational potential energy of 86 000 000 J

The gravitational field strength of the Moon is 1.6 N/kg

_____

_____

_____

_____

_____

_____

Height = _____ m

(3)

(Total 12 marks)

Q5.

Astronauts have landed on the Moon on six separate occasions.

(a) The Moon is in a circular orbit around the Earth. The speed of the Moon is constant.

Explain why the Moon is accelerating.

_____

_____

_____

_____

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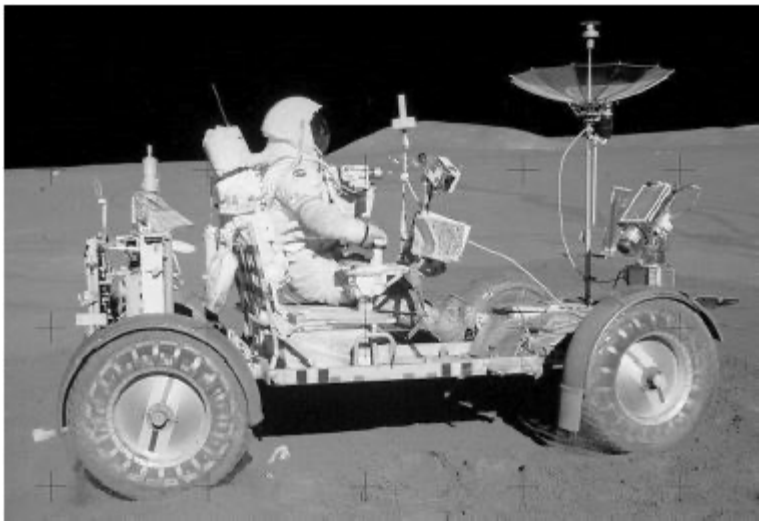
_____

_____

(3)

The astronauts moved around the surface of the Moon in a lunar rover.

The photograph below shows a lunar rover.



(b) At one point, the lunar rover accelerated from 1.4 m/s to 2.6 m/s

The acceleration of the lunar rover was 0.31 m/s^2

Which calculation could be used to calculate the distance travelled s during this acceleration?

Tick **one** box.

$s = \sqrt{2.6^2 - 1.4^2 - 2 \times 0.31}$ ☐

$s = \dfrac{1.4^2 - 2.6^2}{2 \times 0.31}$ ☐

$s = \dfrac{2.6^2 - 1.4^2}{2 \times 0.31}$ ☐

$s = \dfrac{2 \times (2.6^2 - 1.4^2)}{0.31}$ ☐

(1)

(c) The lunar rover used four electric motors connected in parallel to a 36 V battery.

The maximum output power of one motor was 190 W

The efficiency of each motor was 72%

Calculate the current drawn from the battery when all four motors were operating at maximum power.

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Current = _____ A

(6)

(d) Scientists once thought that the Moon formed elsewhere in the solar system and later came to orbit the Earth.

Studies of Moon rocks brought back by the astronauts showed that the rocks were extremely similar to those found on Earth.

This led to a new theory about how the Moon formed called the 'Giant Impact Hypothesis'.

According to the Giant Impact Hypothesis, a small planet collided with the Earth. Molten rock thrown up by the collision then formed the Moon.

Suggest why a new theory was developed.

(2)

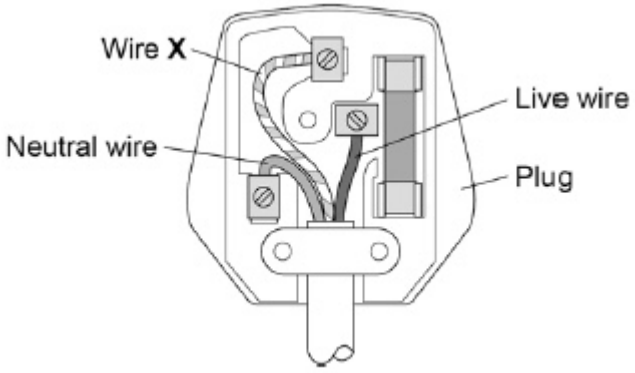
(Total 12 marks)

Q6.

Figure 1 shows a three pin plug connected to the cable of a metal toaster.

Figure 1

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(a) Name wire **X**.

_____

(1)

(b) What does wire **X** do?

Tick **one** box.

It provides extra energy to the toaster when needed.	☐
It completes the circuit in the toaster.	☐
It can prevent an electric shock from the toaster.	☐
It supplies the current to the toaster.	☐

(1)

(c) The toaster is plugged in to the mains electricity supply.

What is the potential difference between the live and neutral wires?

Tick **one** box.

0 V ☐ 120 V ☐ 230 V ☐ 460 V ☐

(1)

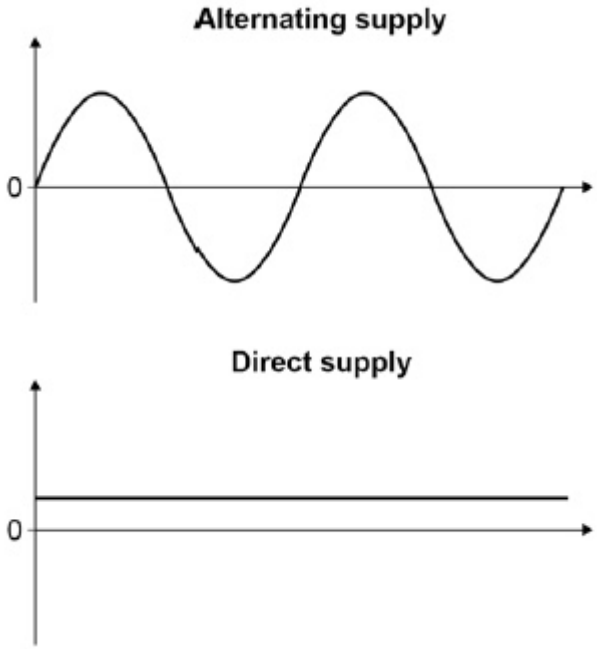
(d) Mains electricity is an alternating supply.

A battery is a direct supply.

Figure 2 shows an alternating supply and a direct supply.

Figure 2

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Give **two** differences between the alternating supply and the direct supply.

1. _____

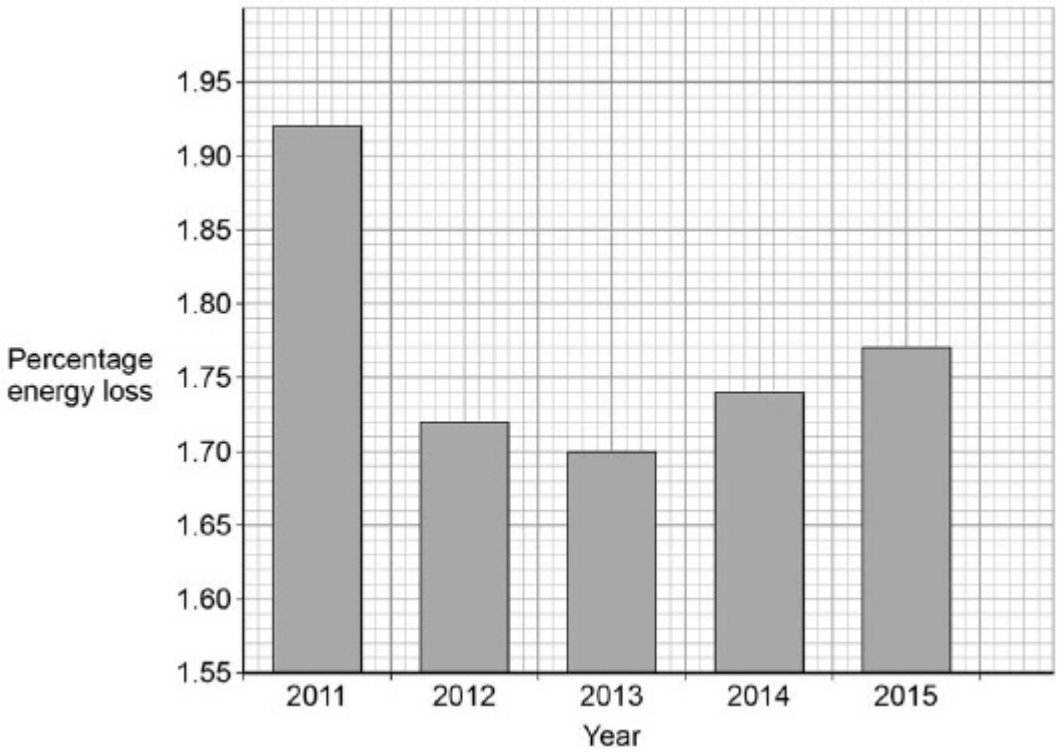
2. _____

(2)

Energy is transferred to homes by the National Grid.

Figure 3 shows the percentage energy losses over the National Grid for different years.

Figure 3



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(e) Describe the changes in percentage energy loss.

_____

_____

_____

_____

(2)

(f) Calculate the mean percentage energy loss per year in **Figure 3**.

_____

_____

_____

_____

_____

_____

Mean energy loss per year = _____ %

(3)

(Total 10 marks)

Q7.

The image shows a girl riding a self-balancing scooter.



(a) The scooter has an electric motor powered by a battery.

During the ride the battery transfers 15 000 C of charge.

The potential difference across the battery is 36 V

Calculate the energy transferred by the battery.

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Use the equation:

energy transferred = charge flow × potential difference

Give your answer in kJ

Energy transferred = _____ kJ

(3)

The table gives data for two scooters with different motors.

Both motors have the same efficiency.

	Power of motor in W	**Mass in kg**
Scooter A	500	10.5
Scooter B	700	14.0

(b) Explain why scooter **B** has a higher maximum speed.

(2)

(c) Both scooters can be ridden for 20 minutes before the battery needs recharging.

Compare the amount of chemical energy stored in the batteries of each scooter.

(1)

(d) Write the equation that links energy transferred, power and time.

(1)

(e) Calculate the energy transferred by the motor in scooter **B** in 20 minutes.

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Energy transferred = _____ J

(3)

(Total 10 marks)

Q8.

Some street lamps contain sodium.

Below are two isotopes of sodium.

$^{23}_{11}Na$ $^{24}_{11}Na$

(a) What are isotopes?

(2)

(b) How many protons and neutrons are in a nucleus of $^{23}_{11}Na$?

Number of protons = _____

Number of neutrons = _____

(2)

(c) The sodium atoms emit light.

What would cause light to be emitted from a sodium atom?

Tick **one** box.

Electrons being emitted from the nucleus. ☐

Electrons falling to a lower energy level. ☐

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Electrons leaving the atom when it is ionised. ☐

Electrons moving to a higher energy level. ☐

(1)

(d) In a street lamp, solid sodium is melted and vaporised.

Describe how the arrangement of the sodium atoms changes as the sodium goes from solid to liquid to gas.

(4)

The table shows the power ratings of some types of sodium lamp.

Type of sodium lamp	Power in Watts
A	35
B	50
C	70
D	100
E	150

(e) Some main roads are lit by type **E** sodium lamps.

Calculate the energy transferred by one type **E** sodium lamp in 1 hour.

Energy transferred = _____ J

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(3)

(f) Many housing estates are lit by type **A** sodium lamps.

Suggest **two** advantages of using type **A** sodium lamps on housing estates.

1. _____

2. _____

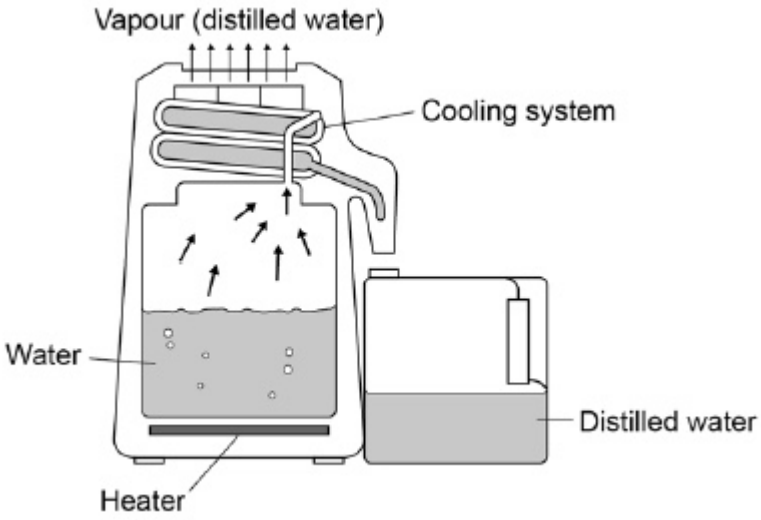
(2)

(Total 14 marks)

Q9.

Figure 1 shows a water distiller which is used to purify water.

Figure 1



The distiller boils water and then condenses most of the water vapour back to water.

(a) The water distiller is filled with 5.0 kg of water at 20 °C

The specific heat capacity of water = 4 200 J/Kg °C

Calculate the energy needed to raise the temperature of the water to 100 °C

Use the Physics Equations sheet.

_____

_____

_____

_____

_____

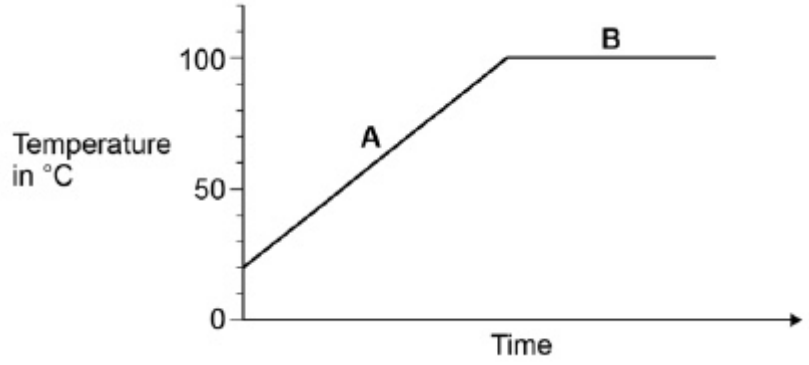
Energy = _____ J

(3)

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Figure 2 shows how the temperature of the water in the distiller changes with time.

Figure 2



(b) Energy is transferred to the water at a constant rate.

Explain why the graph is a different shape in parts **A** and **B**.

_____

_____

_____

_____

_____

_____

(3)

(c) When the water drops to a low level, the heater automatically switches off.

Explain what problem would be caused if the heater did **not** automatically switch off.

_____

_____

_____

_____

_____

_____

(3)

(d) The distiller is connected to the mains by a three-core cable.

The wires are covered by different coloured insulation.

What colour is the insulation covering each of the wires?

Live wire _____

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Neutral wire _____

Earth wire _____

(2)

(e) Which statement gives the purpose of the earth wire?

Tick **one** box.

It carries an alternating potential difference.	☐
It melts if the current in the circuit is too high.	☐
It provides a connection to complete the circuit.	☐
It stops the casing of the appliance becoming live.	☐

(1)

(f) The heating element has a power of 2.5 kW

The resistance of the heating element is 17 Ω

Calculate the current in the heating element.

Give your answer to 2 significant figures.

Write any equations that you use.

_____

_____

_____

_____

_____

_____

_____

_____

Current = _____ A

(5)

(Total 17 marks)

Q10.

Most electrical appliances are connected to the mains electricity using three-core cables.

(a) What is the approximate value of the potential difference of the UK mains electricity supply?

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Tick **one** box.

23 V ☐

230 V ☐

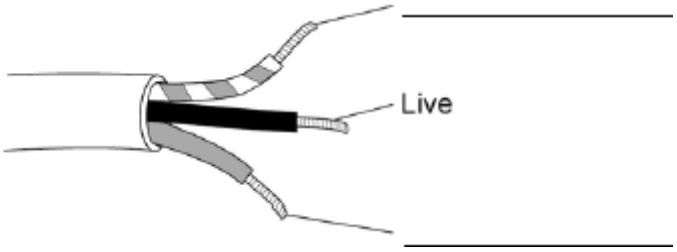
300 V ☐

350 V ☐

(1)

(b) **Figure 1** shows a three-core cable.

Figure 1



Use answers from the box to label the wires and complete **Figure 1**.

Earth	**Negative**	**Neutral**

(2)

(c) In the UK the three wires in a three-core cable are always the same colours.

Why are the wires always the same colours?

Tick **one** box.

Each wire is made by a different company. ☐

It is easy to identify each wire. ☐

They are cheaper to manufacture. ☐

(1)

(d) Touching the live wire is dangerous.

Use answers from the box to complete the sentences.

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current	resistance	shock	force	voltage

Touching the live wire causes a large potential difference to exist across the body.

This causes a _____ through the body, which

results in an electric _____

(2)

(e) What is the approximate frequency of the UK mains electricity supply?

Tick **one** answer.

50 Hz ☐

75 Hz ☐

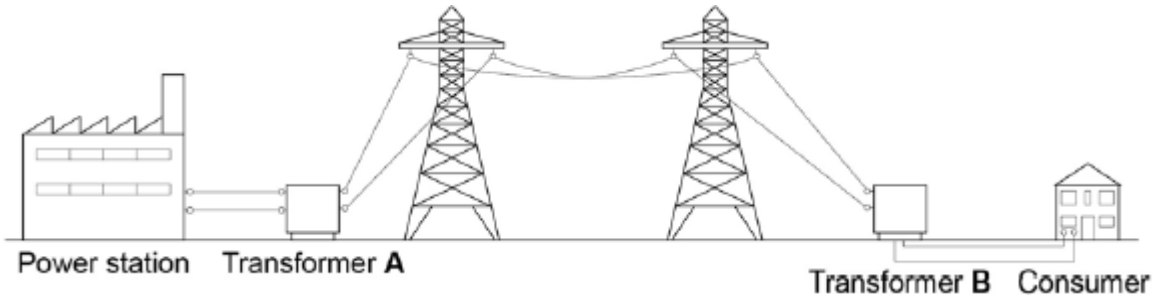
100 Hz ☐

150 Hz ☐

(1)

(f) **Figure 2** shows how power stations transfer electrical power to consumers using the National Grid.

Figure 2



The power station generates electricity at a voltage of 25 kV.

Transformer **A** increases the voltage by a factor of 16.

What is the voltage output of transformer **A**?

_____

_____

_____

Output voltage = _____ kV

(2)

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(g) Why is the voltage increased by transformer **A**?

Tick **one** box.

To reduce the energy lost due to heating	☐
To increase the power	☐
To increase the current	☐

(1)

(h) Why is it important that the voltage is decreased by transformer **B**?

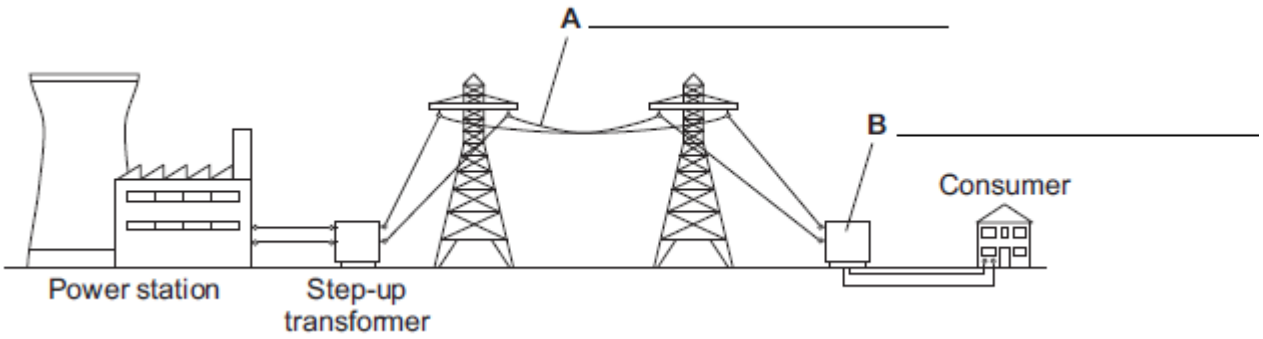
Tick **one** box.

Less energy is used by consumers	☐
It is safer for consumers	☐
It reduces consumers' electricity bills	☐

(1)
(Total 11 marks)

Q55.

The diagram shows how electricity is distributed from a power station and transmitted along the National Grid.



(a) Complete labels **A** and **B** on the diagram.

(2)

(b) Use the correct word from the box to complete each sentence.

decreased	**increased**	**unchanged**

The output voltage of the power station is _____ by

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the step-up transformer.

The output current of the power station is decreased.

These changes mean that the energy losses between the power station and

the consumer are _____ .

(2)

(c) Power stations may burn coal, gas or oil to generate electricity.

The table below gives information about three different types of power station.

Type of power station	Start-up time
Coal	Long
Gas	Short
Oil	Medium

Which type of power station, coal, gas or oil, is used to meet a sudden demand for electricity?

Tick (✓) **one** box.

Coal ☐

Gas ☐

Oil ☐

Give a reason for your answer.

_____

_____

(2)

(Total 6 marks)

Q56.

Nuclear fuels and fossil fuels are non-renewable energy sources.

(a) Power stations generate electrical power.

Describe the similarities and differences between generating power using nuclear fuels and using fossil fuels.

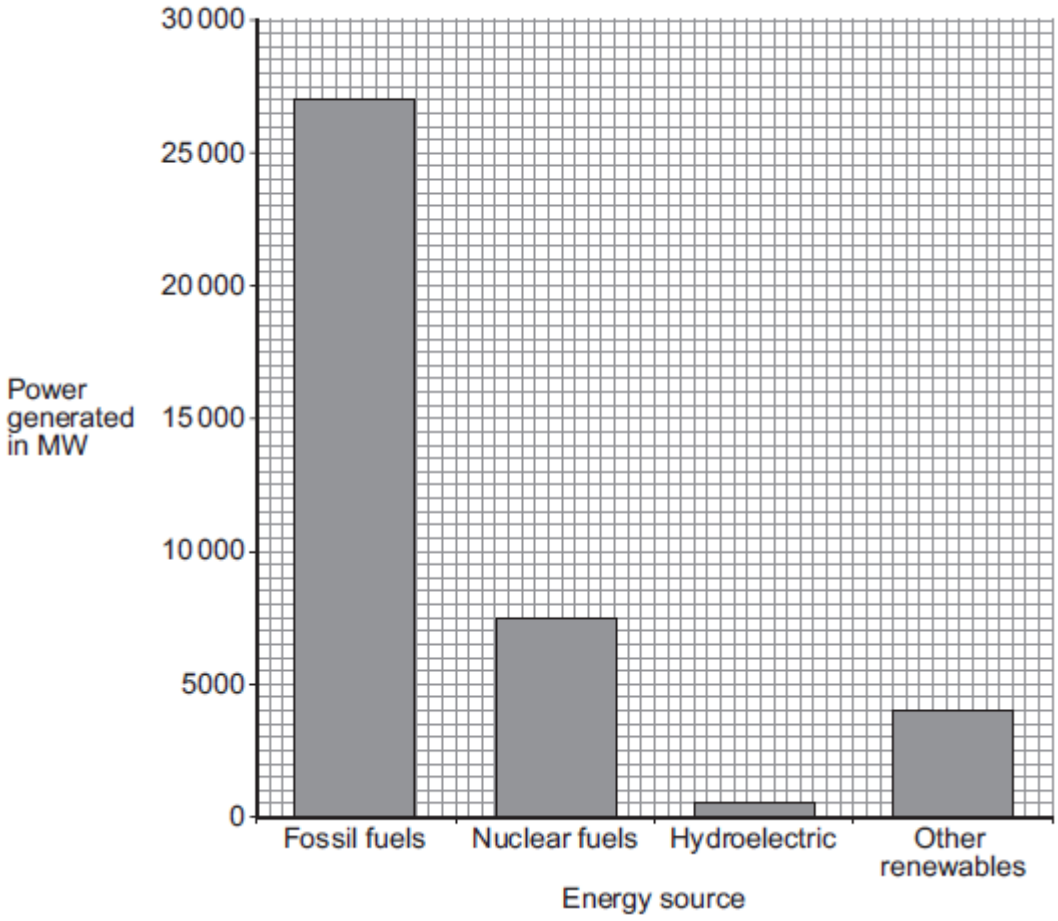
_____

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(4)

(b) **Figure 1** shows the power generated using different energy sources in the UK.

Figure 1



(i) Nuclear fuels are less readily available, and more expensive, than fossil fuels.

Suggest **two** other reasons why nuclear fuels are used **less** than fossil fuels to generate power.

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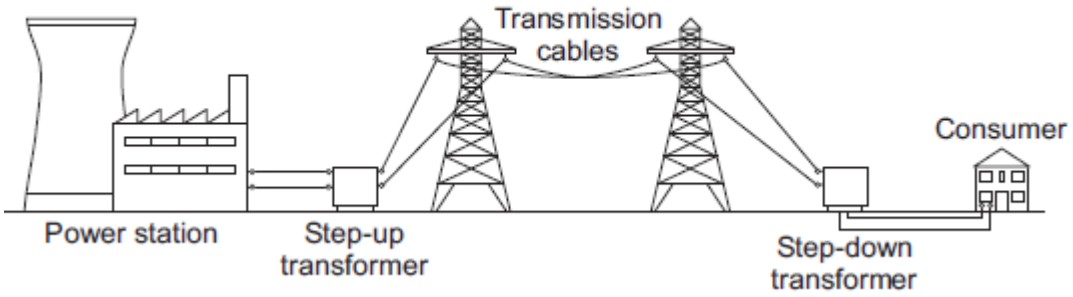
(2)

(ii) Suggest **two** reasons why the proportion of power generated using fossil fuels might decrease in the future.

(2)

(c) **Figure 2** shows how power is distributed from a power station and transmitted along the National Grid.

Figure 2



Explain why step-up transformers are included in the National Grid.

(3)

(d) Shale gas is natural gas trapped in rocks. The shale gas can be extracted by a process called fracking. The shale gas can then be used as a fuel.

Part of a news report on fracking is shown below.

Fracking is a process used to extract shale gas from difficult-to-reach places.

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Fracking will provide more shale gas, so gas prices may go down. If shale gas was used in power stations, less carbon dioxide would be produced than if coal was used in power stations.

Many possible fracking sites are close to built-up areas. Some local people are opposed to fracking. A lot of water needs to be transported to the fracking site. The process of fracking uses chemicals known to cause cancer and these chemicals may escape and contaminate the water supply. Some local people also worry that fracking may cause small earth tremors. These people say fracking is discouraging energy companies from investing money in renewable sources of energy.

Use information from the news report and your own knowledge to suggest, with reasons, why some local people are opposed to fracking.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 14 marks)

Q57.

The cost of electricity is increasing. People want to use devices that are more energy efficient.

(a) What does *energy efficient* mean?

Tick (✓) **one** box.

Statements	Tick (✓)
Energy efficient means a low energy input.	
Energy efficient means a small proportion of wasted energy.	
Energy efficient means a small proportion of useful energy.	

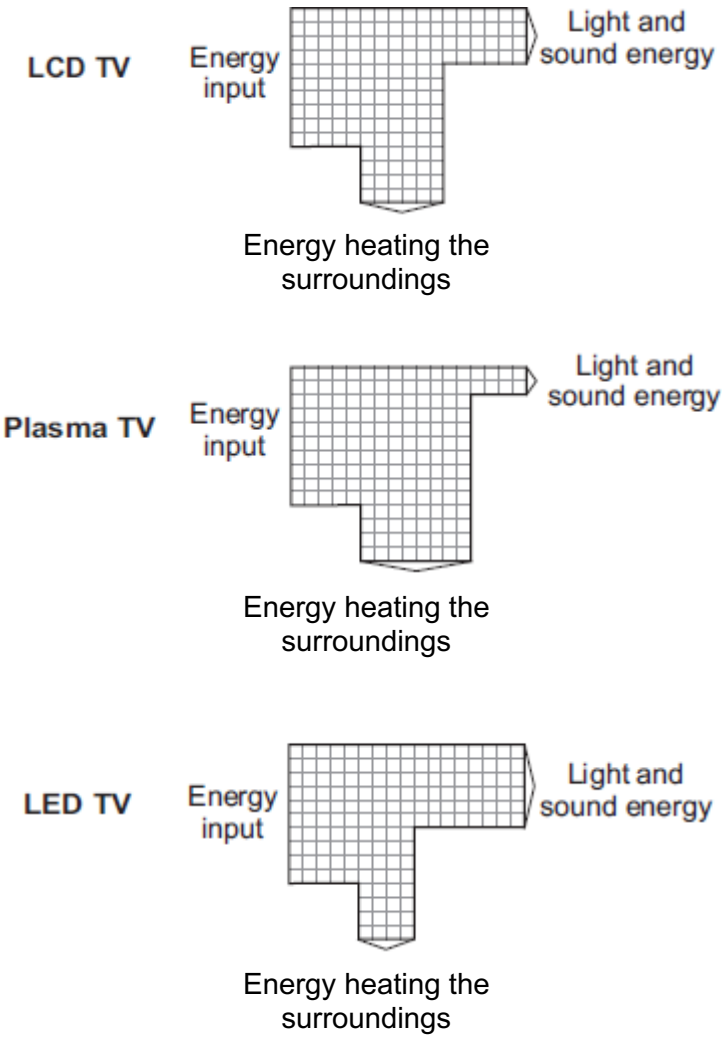
(1)

(b) A householder is trying to decide which TV to buy. The choice is between an LCD TV, a Plasma TV and an LED TV. The TVs had the same sized screens.

The Sankey diagrams show the proportion of the input energy that is transferred to

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different energy forms by the three TVs.



Which TV wastes the largest proportion of the input energy?

_____

(1)

(c) The power rating of a TV when in use is 0.3 kW.

Calculate the energy used by the TV when in use for 6 hours.

Use the correct equation from the Physics Equations Sheet.

Draw a ring around the correct unit.

_____

_____

_____

_____

kW

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Energy used = _____

kWh

W

(3)

(Total 5 marks)

Q58.

A hairdryer is supplied with 800 J of energy every second.



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(a) Describe **all** the energy transfers that take place in the hairdryer when it is being used.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Why must the total energy output of the hairdryer always equal the total energy input to the hairdryer?

_____

_____

(1)

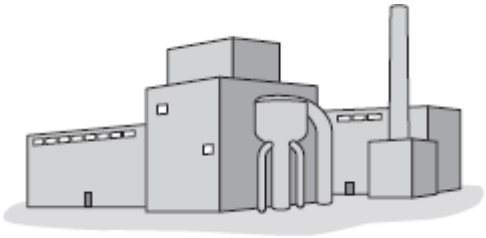
(Total 5 marks)

Q59.

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A company has planning permission to build a biofuel power station on the edge of a city.

A local newspaper publishes a picture of the proposed power station.



(a) Which of these is a biofuel?

Draw a ring around the correct answer.

coal **oil** **uranium** **wood**

(1)

(b) The biofuel power station will be connected to the National Grid using overhead power lines instead of underground cables.

Tick (✓) **one** advantage and **one** disadvantage of overhead power lines.

		Tick (✓)
Advantage	Overhead power lines transmit electricity more quickly than underground cables.	
	Overhead power lines cost more to install than underground cables.	
	Breaks in overhead power lines are easier to find than in underground cables.	

		Tick (✓)
Disadvantage	Overhead power lines transmit electricity more slowly than underground cables.	
	Overhead power lines are more dangerous than underground cables if they break.	
	Overhead power lines are more difficult to repair than underground cables.	

(2)

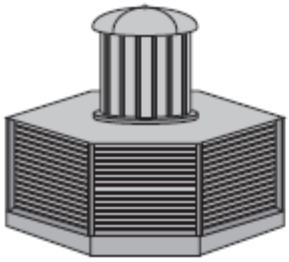
(Total 3 marks)

Q60.

A community of people living on an island are considering buying wind turbines to supply their electricity. The community have looked at two types of wind turbine.

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Vertical Axis Wind Turbine



Horizontal Axis Wind Turbine



Not to scale

The community looked at information about the two different types of wind turbine.

• **Vertical axis wind turbines** start to rotate at wind speeds of 1.5 m/s. • Vertical axis wind turbines are powered by wind coming from any direction. • The power output at 12 m/s is 1 MW. • The wind turbines continue to generate electricity until the wind speed reaches 40 m/s.	• **Horizontal axis wind turbines** start to rotate at wind speeds of 3.6 m/s. • Horizontal axis wind turbines turn to point into the wind. • The power output at 12 m/s is 1 MW. • At very high wind speeds, above 20 m/s, the wind turbines stop working automatically to avoid damage.

(a) The community decide that vertical axis wind turbines would be better.

Use the information given to suggest why.

_____

_____

_____

_____

_____

_____

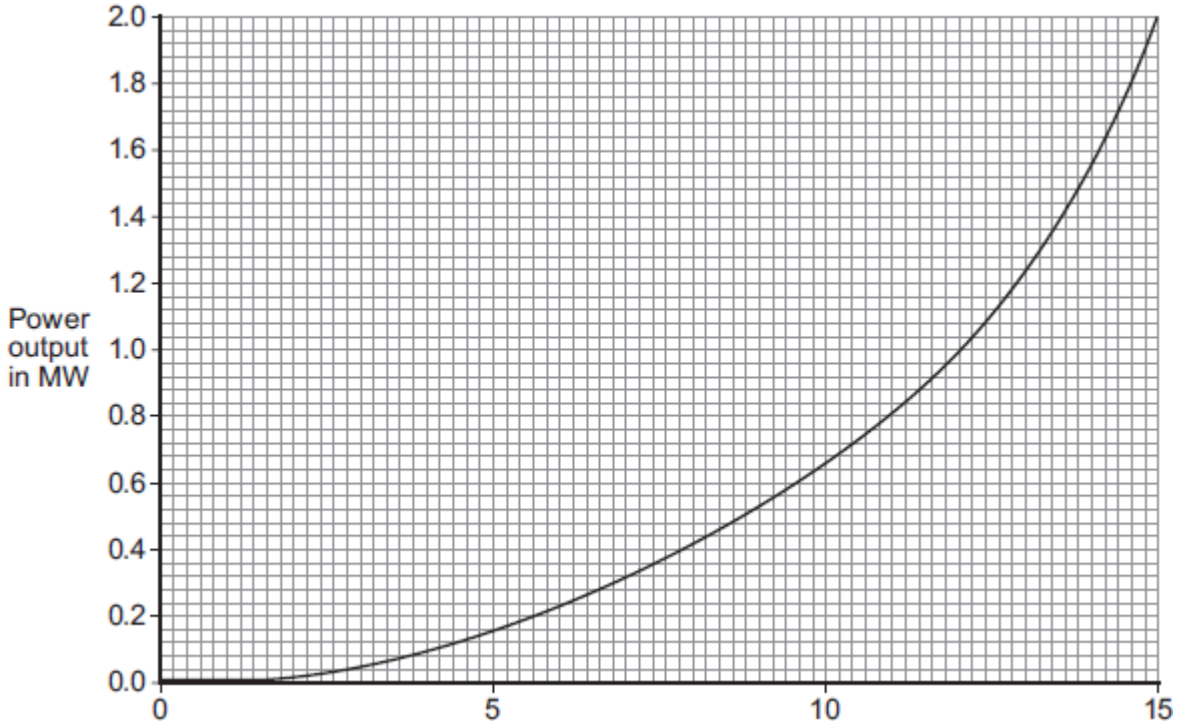
_____

(3)

(b) **Graph 1** shows how the power output varies with wind speed for a vertical axis wind turbine.

Graph 1

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Describe how the power output of this wind turbine varies with wind speed for the range of wind speeds shown.

_____

_____

_____

_____

(2)

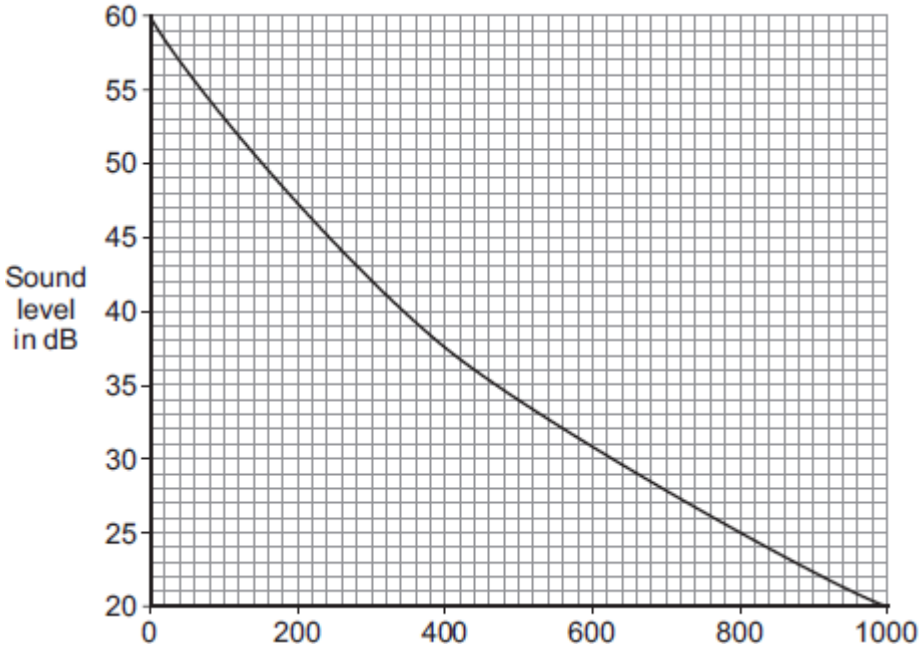
(c) Some local people do not want the wind turbines. These people say the wind turbines are too noisy.

Graph 2 shows how the sound level detected changes with distance from a wind turbine.

Sound level is measured in decibels, dB.

Graph 2

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The sound level of a normal conversation is 50 dB.

(i) How far from the wind turbine would a person need to stand to detect a sound level of 50 dB?

Distance = _____ metres

(1)

(ii) The graph shows that 1000 m away you can still hear the noise the wind turbines produce.

A sound level of 30 dB is the same as a person whispering in another person's ear.
The nearest house to the wind turbine is 1000 m away.

Some people do not want the wind turbines because of the noise the wind turbines produce.

Are these people justified in not wanting wind turbines?

Give reasons for your answer.

_____

_____

_____

_____

(2)

(d) On the mainland, wind turbines are connected to the National Grid.

Electricity is transmitted through the power lines of the National Grid at very high voltages and low currents.

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State why.

_____

_____

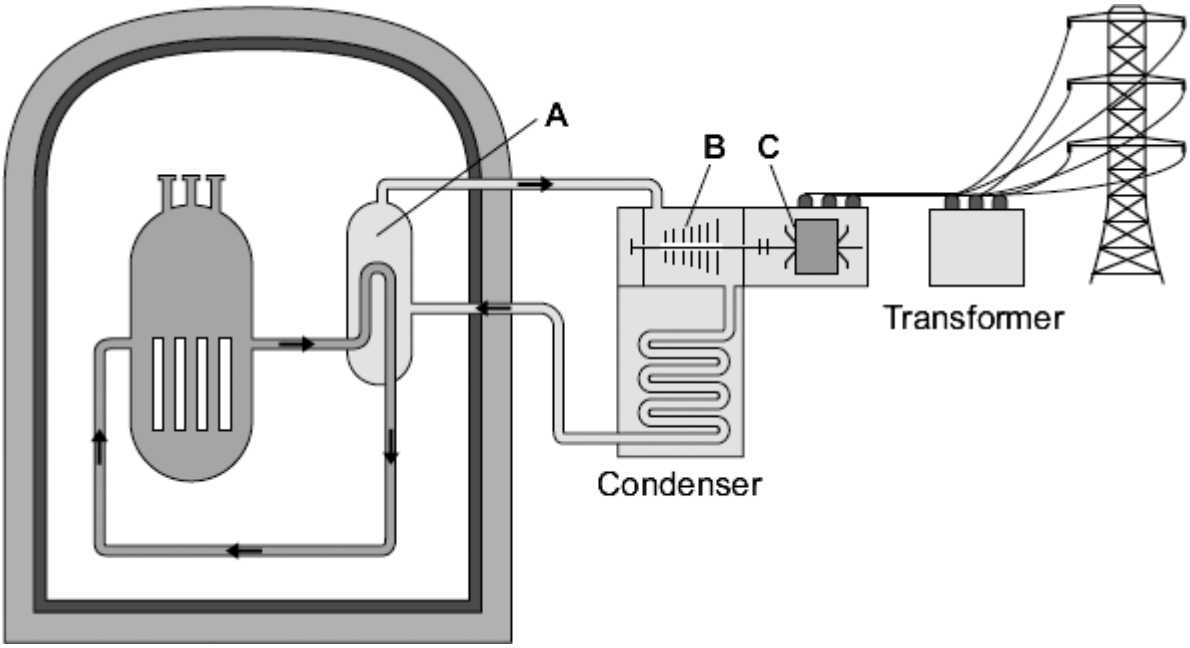
(1)

(Total 9 marks)

Q61.

A nuclear power station generates electricity using nuclear fuel.

The diagram below shows a nuclear power station.



(a) The transformer changes the voltage of the electricity generated by the power station.

(i) What type of transformer is shown in the diagram?

_____

(1)

(ii) Changing the voltage increases the efficiency of the power transmission.

Explain how.

_____

_____

_____

_____

(2)

(b) A country generates 80% of its electricity using fossil fuel power stations.

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The country's government is considering replacing all of its fossil fuel power stations with nuclear power stations.

Suggest **two** factors that the country's government will have to consider in making a decision.

_____

_____

_____

_____

(2)

(Total 5 marks)

Q62.

A battery powered electric fan is used to move air around a room.



Photograph supplied by Comstock/Thinkstock

(a) Use words from the box to complete each sentence.

chemical	light	kinetic	electrical	sound

In the batteries, _____ energy is transferred to

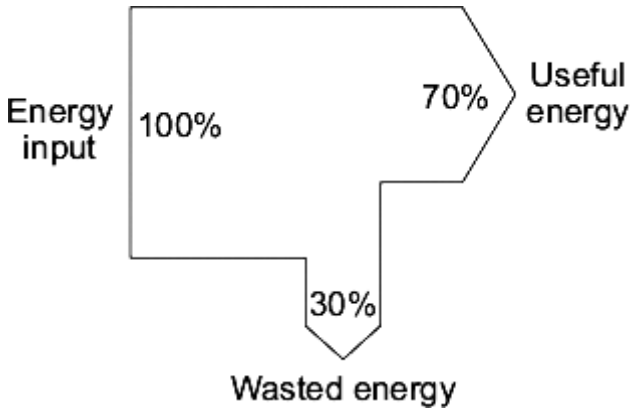
_____ energy in the wires.

The fan has _____ energy as it rotates.

(3)

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(b) The Sankey diagram shows how much energy is usefully transferred when the fan is being used.



(i) What is the efficiency of the fan?

_____

(1)

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

All of the energy from the fan is eventually transferred to the surroundings.

This makes the temperature of the surroundings

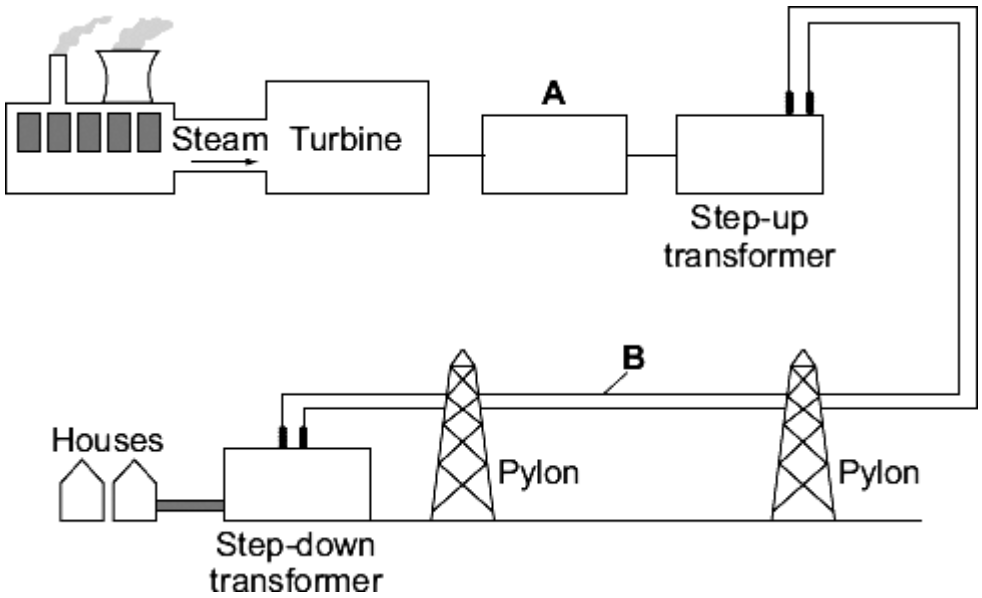
increase.
decrease.
stay the same.

(1)

(Total 5 marks)

Q63.

The diagram shows how electricity is generated, and transmitted by the National Grid.



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(a) Name the parts labelled **A** and **B**.

(i) Part **A** _____

(1)

(ii) Part **B** _____

(1)

(b) The step-up transformer makes changes to the electricity supplied by the power station.

Use words from the box to complete each sentence.

current	**energy**	**power**	**voltage**

The step-up transformer increases the _____ of the supply.

The step-up transformer decreases the _____ of the supply.

(2)

(c) Information about five different types of power stations is given in the table.

Power station	**Start-up time**	**Power output in MW**
Biomass	Medium	20
Geothermal	Medium	30
Nuclear	Long	1200
Hydroelectric	Short	2000
Wind turbine	Short	5

(i) Which power station would be best to meet peak demands for electricity?

_____

(1)

(ii) Which power station uses a non-renewable energy resource?

_____

(1)

(iii) Wind turbines are used to generate electricity.

Give **one** advantage and **one** disadvantage of using wind turbines to generate electricity.

Advantage _____

_____

Disadvantage _____

_____

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(2)
(Total 8 marks)

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