

PHYSICS



EXAM QUESTION PACK

P8.2 POWERING EARTH

SCORE

/225

PERCENTAGE

%

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Gateway Physics A (9-1)

Powering Earth

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:

Additional resources may be supplied with this paper.

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate
forename

Candidate
surname

Centre number

Candidate number

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **225**.
- The total number of marks may take into account some 'either/or' question choices.

1 Which correctly describes electricity supply to homes in the UK?

- A 50 Hz a.c.
- B 50 Hz d.c.
- C 230 Hz a.c.
- D 230 Hz d.c.

Your answer

[1]

2 Why are high voltages used to transfer electrical power from power stations in the National Grid?

- A allows low resistance wires to be used.
- B produces a higher current.
- C reduces energy losses.
- D voltage can be changed using transformers.

Your answer

[1]

3(a) Many power stations burn fuels to generate electricity.

Fuels can be renewable or non-renewable.

Wood is used in some power stations.

Why is it called a renewable fuel?

-----[1]

(b) Rachael has completed her homework on fuels used in power stations.

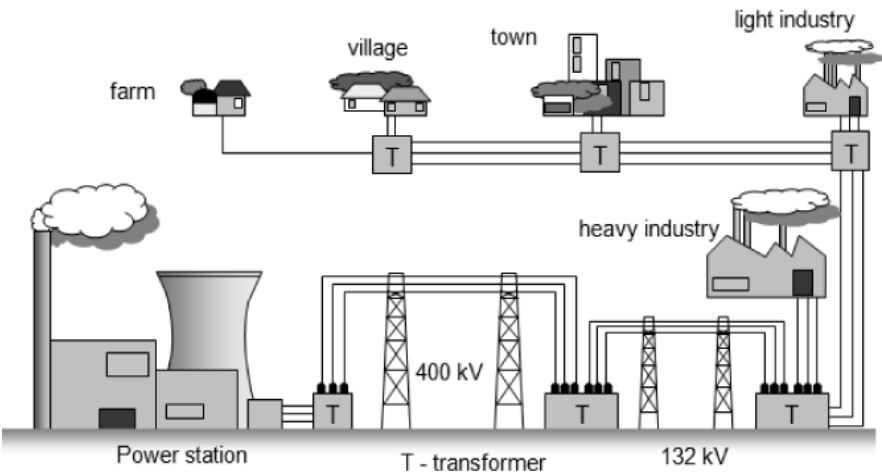
Look at her table below.

Fuel	Type
Wood	renewable
Plant and vegetable oils	renewable
Peat	non-renewable
Coal	renewable
North Sea gas	non-renewable
Uranium	renewable

She has made **two** mistakes, identify these in the table by putting a cross (x) next to them.

[2]

(c) Power stations produce electrical energy and use the National Grid to send it to factories and homes in the UK.



A step-up transformer is used in the National Grid.

State what a step-up transformer does.

[1]

(d) Domestic UK electrical wiring uses live, neutral and earth wires.

Complete the two empty boxes and then draw lines to match up the wires to their colour and function.

Wire	Colour	Function
Live		Completes the circuit
Earth	brown	
Neutral	yellow and green	Has a high potential difference

[4]

4 The National Grid transfers energy efficiently using high voltages.

Why are high voltages more efficient?

- A High voltages produce a high current which heats wires less.
- B High voltages produce a low current which heats wires more.
- C High voltages produce a high current which heats wires more.
- D High voltages produce a low current which heats wires less.

Your answer

[1]

5 Which row correctly describes the domestic electricity supply in the UK?

	a.c. or d.c.	frequency (Hz)	voltage (V)
A	a.c.	50	230
B	a.c.	230	50
C	d.c.	50	230
D	d.c.	230	50

Your answer

[1]

6 Voltage is increased before transmission through the National Grid.

It is increased from 25 000 V up to 400 000 V. This increases the voltage 16 times.

(i) How much would this increase in voltage affect the current?

----- [2]

(ii) Use the formula: $\text{power} = \text{current}^2 \times \text{resistance}$

to explain why this voltage increase is important to power loss in transmission cables.

----- [2]

7 Jin's car runs on petrol. Petrol is a fossil fuel.

She would like a car that does not use fossil fuels so that she can reduce her effect on the environment.

(i) Write down two possible alternatives to fossil fuels for cars.

1

2

[2]

(ii) Jin thinks that some alternatives may not be suitable to use in the UK.

Suggest **one** alternative that may not be suitable.

Explain your answer.

[1]

8 Alec designs a house.

He wants the house to use **renewable** energy from the Sun.

He would like to use both of these methods:

- passive solar heating
- photocells.

Describe how Alec can use these two methods in his house to help reduce pollution to the environment. Explain how he can maximise the energy he collects by using these methods.



The quality of written communication will be assessed in your answer to this question.

[6]

9(a) This question is about power stations.



Power stations generate electricity.

Name two **fossil** fuels used in power stations.

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

(b) Name one **renewable** fuel used in power stations.

----- [1]

(c) Complete the sentences.

Electricity is generated in power stations.

It is transmitted around the UK through a system of power lines called the ----- .

This system connects the power station to **consumers** such as

----- and ----- .

[2]

10 Elin's mains supply is 230 V.

The electricity company transmits electricity through the National Grid at a higher voltage of 400 000 V.

This reduces energy waste for the company.

Explain why.

----- [2]

11 We use electricity to provide energy in our everyday activities.

Look at the table.

It shows the average electrical energy in kWh used per person each day in different countries.

Country	Average electrical energy used per person each day in kWh
Austria	4.3
Belgium	6.2
Denmark	5.2
Finland	9.7
France	5.8
Germany	4.3
Ireland	4.6
Luxembourg	4.4
Norway	20.5
Sweden	12.9
Switzerland	5.8
UK	5.0

(i) In the UK the Smith family use 7 300 kWh of electrical energy in a year (365 days).

Use the figures in the table to calculate the number of people in the Smith family.

Show your working.

answer ----- people [2]

(ii) The average electrical energy use **per person** each day in the UK is less than that in Belgium.

However, as a country, Belgium uses less electrical energy than the UK.

Suggest a reason why.

----- [1]

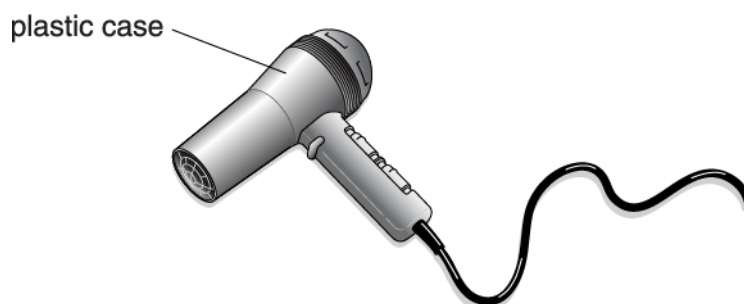
12 The National Grid transfers power from power stations to homes and factories.

The transmission voltages in the National Grid are very high.

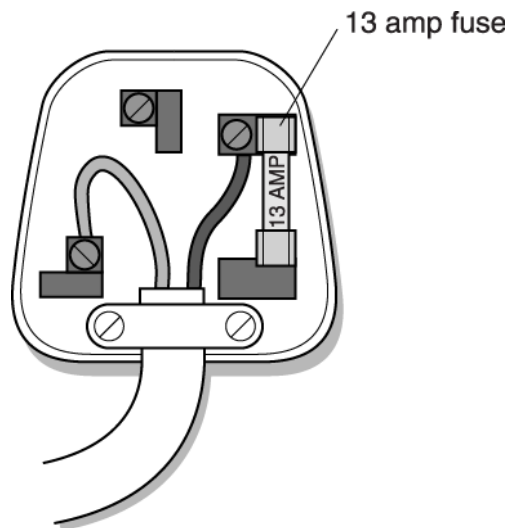
Describe one **risk** and one **benefit** of using high voltages to transmit electricity.

----- [2]

13 Carly has a hair dryer. The hair dryer has a plastic case as well as an insulated cable.



She attaches a plug to the hair dryer.



Explain why the plug only needs two wires and a fuse.

Explain why this fuse needs to be 13 amp rather than a 3 amp.



The quality of written communication will be assessed in your answer to this question.

[6]

14 We use electricity to provide energy in our everyday activities.

Look at the table.

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Germany	4.3
Ireland	4.6
Luxembourg	4.4
Norway	20.5
Sweden	12.9
Switzerland	5.8
UK	5.0

(i) In the UK a person uses an average of 5.0 kWh of electrical energy each day.

How much would a family of 4 people use on average in 7 days?

answer ----- kWh [2]

(ii) Which countries in the table use the lowest amount of electrical energy per person each day?

----- [2]

(iii) In Norway some people only use about 7 kWh of electrical energy each day.

This is much less than the average amount of electrical energy used, which is 20.5 kWh.

Suggest how these two figures can both be correct.

----- [1]

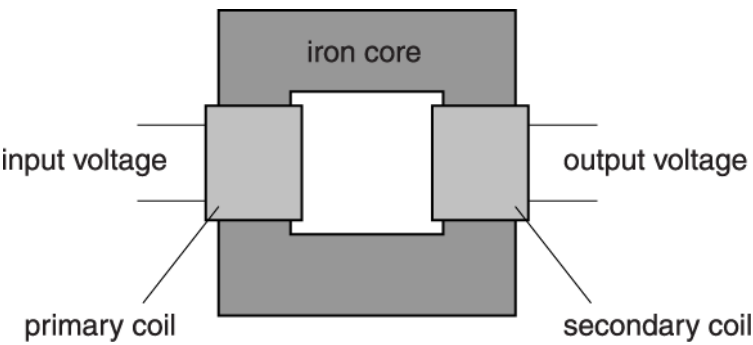
(iv) The average electrical energy use **per person** each day in the UK is less than that in Belgium.

However, as a country, Belgium uses less electrical energy than the UK.

Suggest a reason why.

----- [1]

15 This question is about transformers.



Transformers are used to change the voltage of an AC supply.

Susan has completed her homework on identifying step-up and step-down transformers.

	Input voltage in V	Output voltage in V	Step-up or step-down
A	10	20	Step-up
B	40	100	Step-down
C	25	50	Step-down
D	50	10	Step-down

Susan spots **two** mistakes in her work.

Which two rows, A, B, C or D are incorrect?

_____ and _____

Explain your choices.

-----[2]

16 This question is about alternating current (AC).

What is the frequency of the mains electricity supply in the UK?

Tick (?) the correct box.

5 Hz

☐

50 Hz

☐

10 Hz

☐

100 Hz

☐

[1]

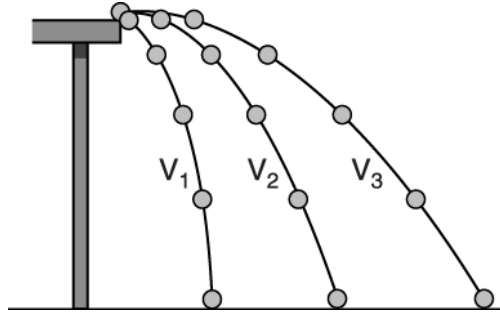
17

She repeats the experiment by rolling the marble at different velocities, V_2 and V_3 .

She uses a camera to show the paths of the marble.

Look at the diagram of her results.

It shows the position of the marble at equal time intervals for each path.



Compare the velocities and describe the paths (V_1 , V_2 and V_3) of the marble.

For path V_3 describe the horizontal and vertical accelerations of the marble.

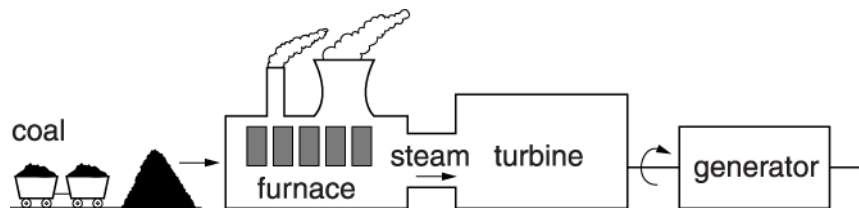


The quality of written communication will be assessed in your answer to this question.

[6]

18 Power stations are used to generate electricity.

Look at the diagram of a power station that uses coal.



(i) Nuclear power stations have some **similarities** to coal power stations.

They both use a fuel.

Describe **one** other way they are similar.

-----[1]

(ii) Nuclear power stations have some **differences** to coal power stations.

Describe **one** way they are different.

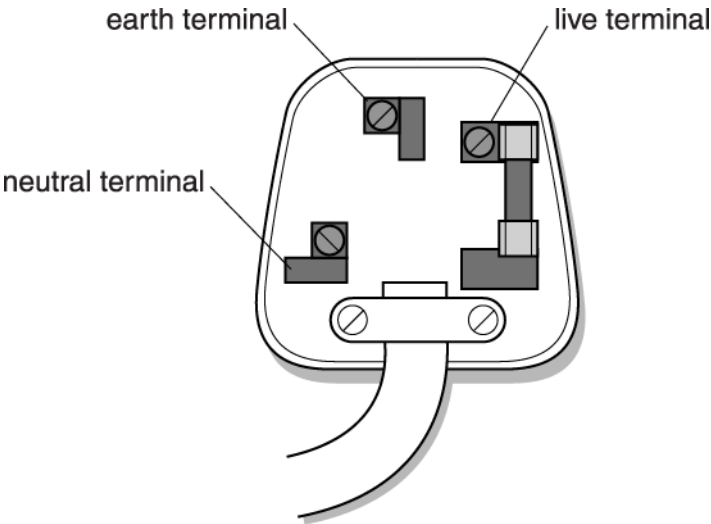
-----[1]

19 Carly needs to attach a new mains plug to her hair dryer.



The hair dryer is a **double insulated** appliance.

She puts a 13 amp fuse in this plug.



Write instructions for connecting the **two** different coloured wires needed in the plug.

Describe why it is important to use a 13 amp fuse.

You may draw on the diagram of the plug to help your answer.



The quality of written communication will be assessed in your answer to this question.

[6]

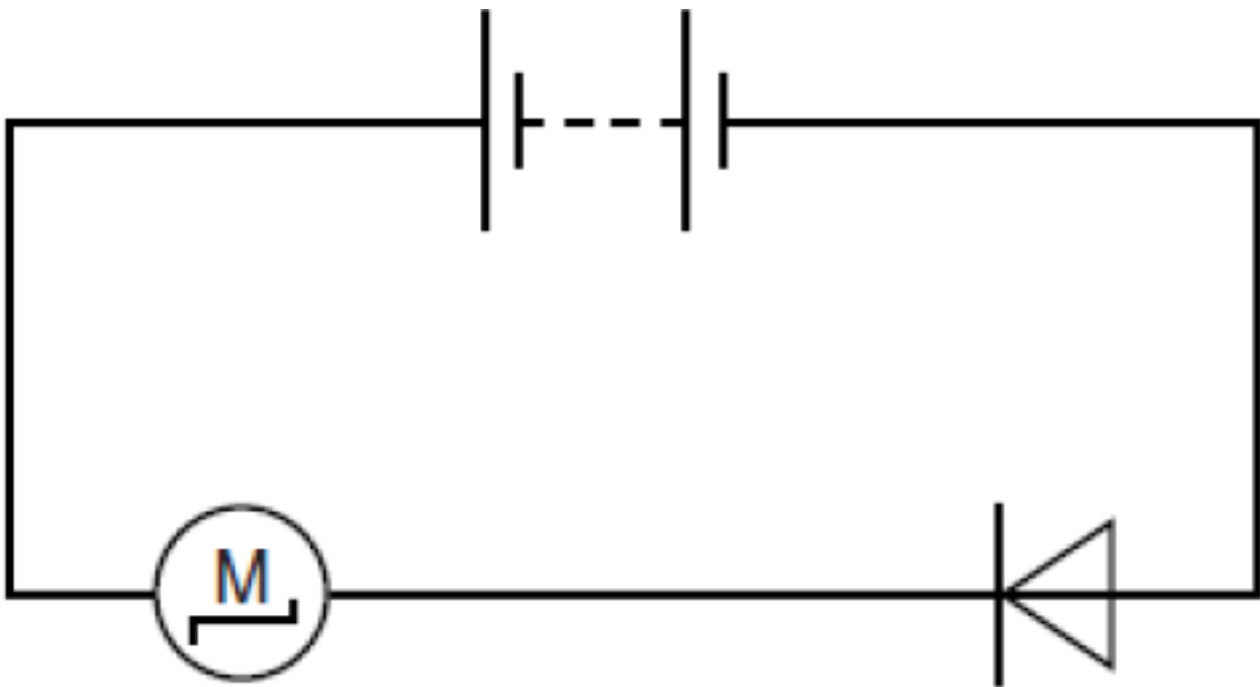
20 Elin's phone charger plugs into the 230 V mains.

The charger reduces the voltage to 12 V.

Name the device in the charger that is used to reduce the voltage.

[1]

21(a) Rob puts a motor in a circuit.



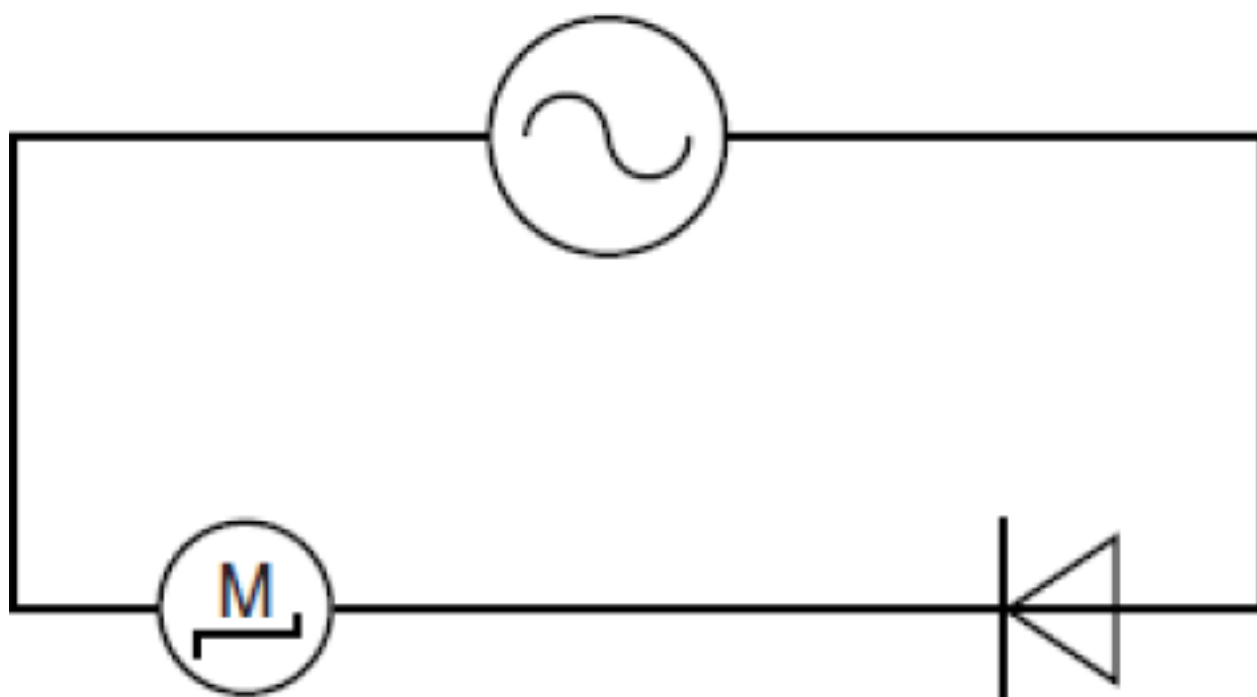
The motor does not turn.

Explain why.

[2]

(b) Rob replaces the battery with an ac supply.

The motor now turns, but not smoothly.



Explain why.

----- [1]

22 This question is about electrical devices.

Look at the information about five different transformers.

Put a tick (?) in the correct column to identify each type of transformer.

The first one has been done for you.

Input voltage	Output voltage	Step up	Step down	Isolating
12	240	?		
500	10			
230	230			
240	80			
1000	10000			

[2]

23 This question is about nuclear energy.

Complete the crossword.

One answer has been done for you.

Across

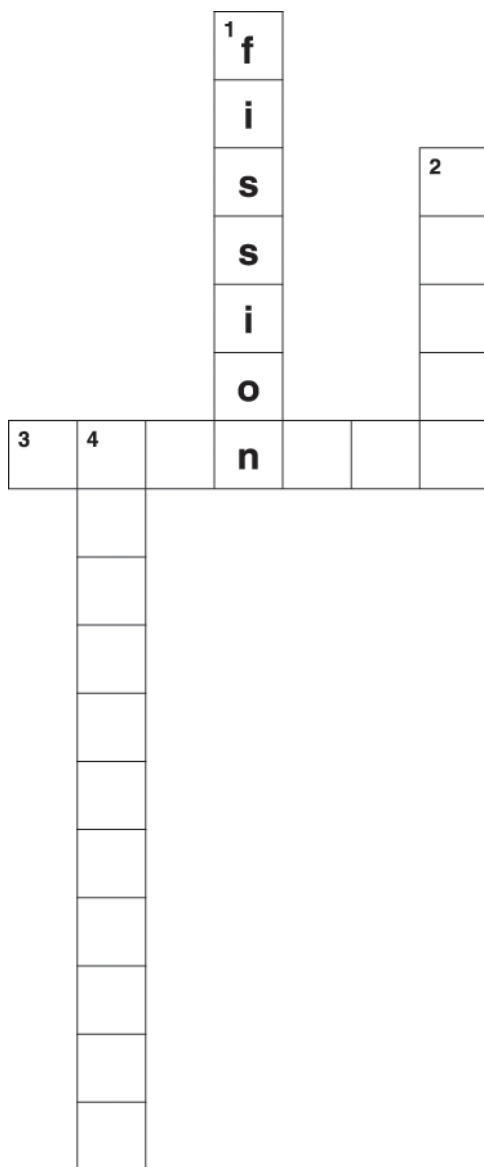
3 A fuel used in a nuclear power station is _____.

Down

1 The process that gives out energy in a nuclear reactor is nuclear **f i s s i o n**.

2 Energy from the reactor is used to heat water turning it into _____.

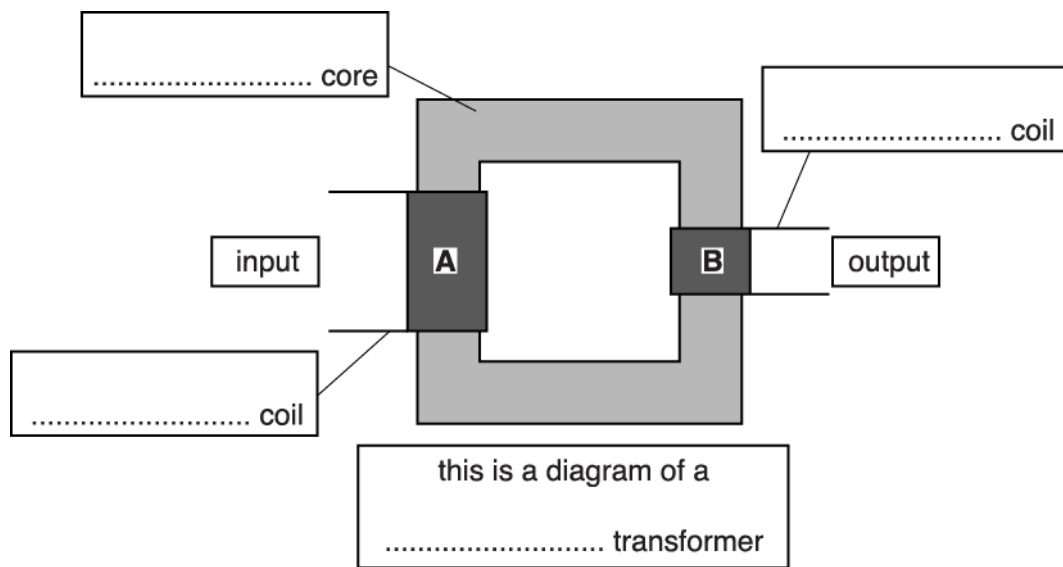
4 The waste produced by the nuclear reaction is _____.



[2]

24(a) Transformers are used in many different appliances.

Look at the simple diagram of a transformer.



A has 4000 turns and B has 150 turns.

(i) Complete the **four** labels on the diagram.

[2]

(ii) The input voltage is 10 000 V.

Calculate the output voltage.

output voltage V

[2]

(b) Transformers are devices that work with alternating current (AC).

Explain why transformers require AC.

[2]

25 The voltage of electricity used in the home is 230 V.

The voltage of electricity used for some power lines is more than 110 000 V.

Transformers are used as part of the National Grid.

Explain why transformers improve the transfer of electricity to the home.

----- [2]

26 Sam's car uses a biofuel.

She says that, over time, this does not increase the amount of carbon dioxide in the atmosphere.

Is she correct?

Explain your answer.

----- [3]

27(a) Electrical power can be generated in many ways.

Look at the data on different types of power generation.

Power generator	% Efficiency
Wind turbine farm	30
Coal power station	34
Nuclear power station	35
Oil power station	32
Gas power station	45

Coal, oil, gas and nuclear are all types of **thermal** power station.

Why are all these called thermal power stations?

----- [1]

(b) Thermal power stations are more efficient than wind turbine farms.

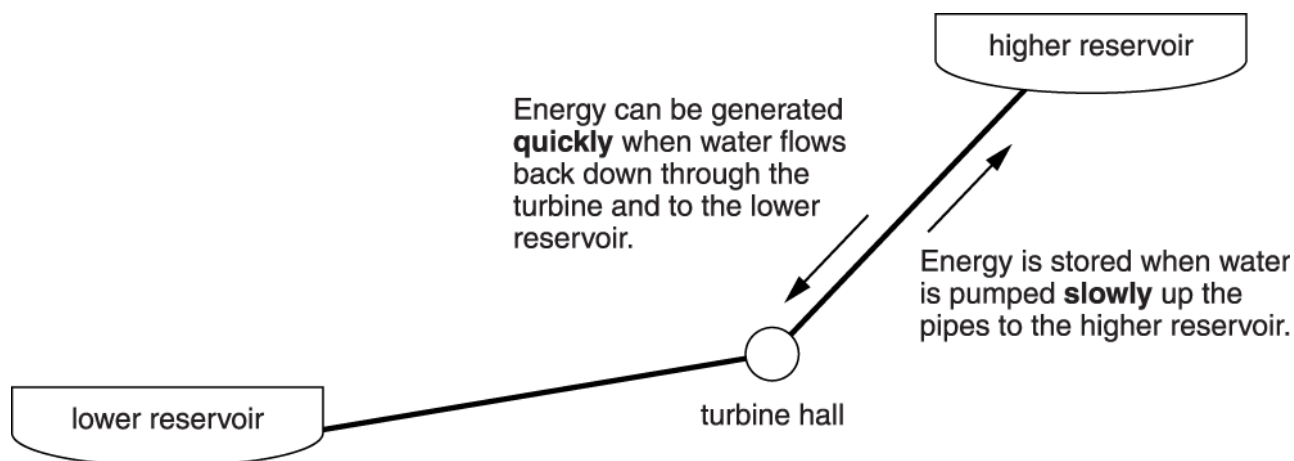
Suggest why wind turbine farms are often preferred to thermal power stations.

-----[1]

Some fuel power stations make use of a pumped storage system to help meet the demand for electricity.

At night, the pumped storage system is used to store surplus energy from the fuel power station.

Look at the diagram of a pumped storage system which uses water.



Explain how the pumped storage system can benefit suppliers and consumers of electricity during a 24 hour period.



The quality of written communication will be assessed in your answer to this question.

[6]

29(a) Nuclear power stations have benefits and risks.

Davinder is worried because he lives near a nuclear power station.

Write about **one risk** of living near a nuclear power station.

Explain how **this** risk is reduced for people living nearby.

[2]

(b) The nuclear power station produces electricity.

The electrical output of the power station is connected to transformers.

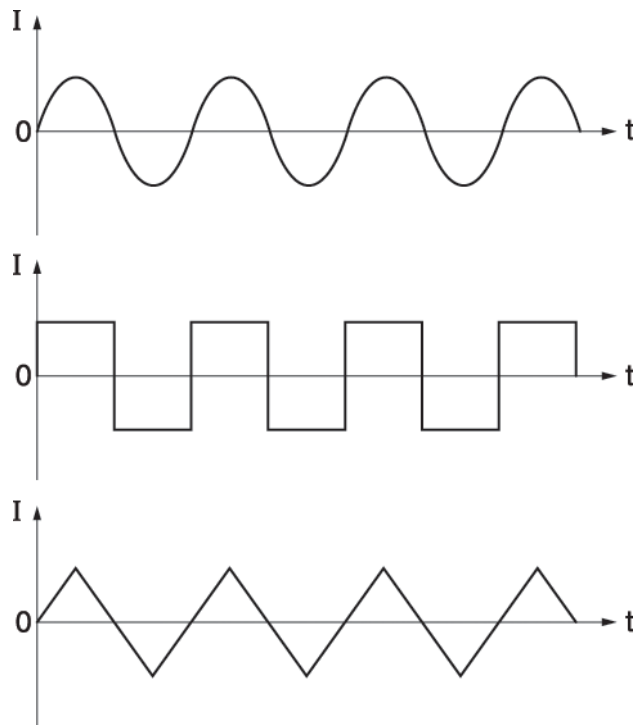
The outputs of these transformers are connected to the National Grid.

Why are these transformers used and how is this important for the National Grid?

[3]

30 A generator in a power station produces alternating current (AC).

Look at the three different current-time graphs.

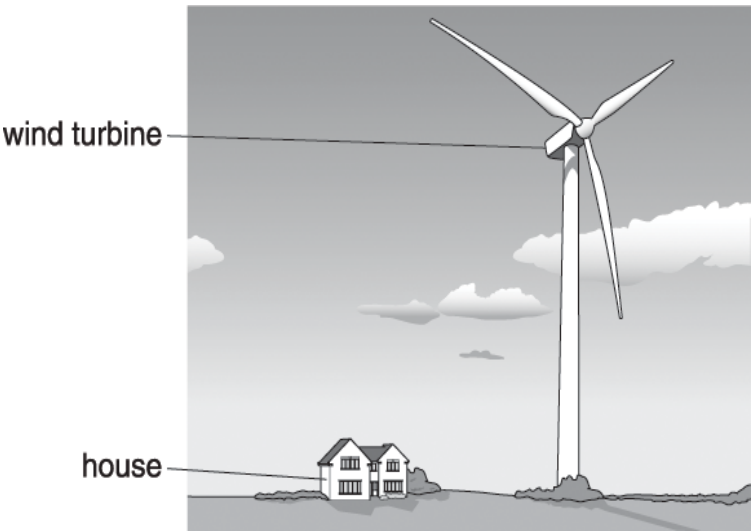


Describe why all the graphs show alternating currents.

----- [1]

31(a) The Sun's energy produces convection currents that cause wind.

Wind is used to drive turbines.



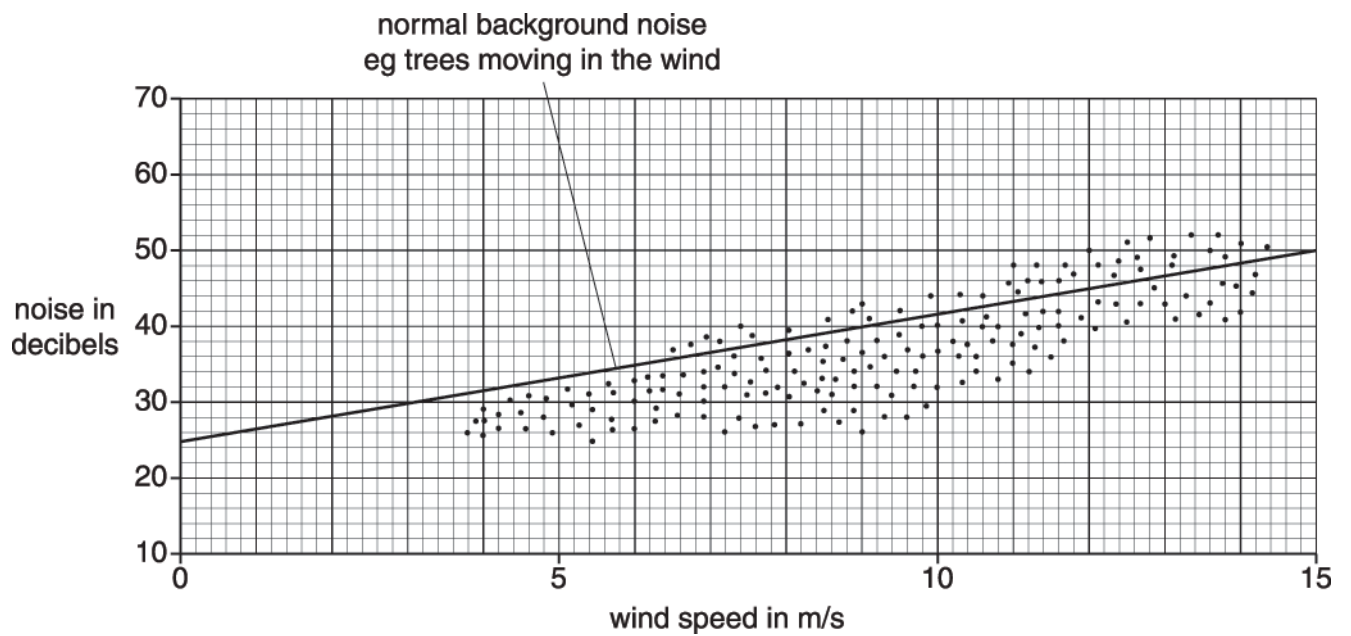
Describe the **advantages** of wind turbines compared to a conventional coal power station.

[2]

(b) The people in the house are concerned about noise from the turbine.

Look at the graph.

Each dot shows a measurement of the noise from the wind turbine.



- (i) Use the graph to describe how the wind turbine noise is affected by wind speed.

----- [1]

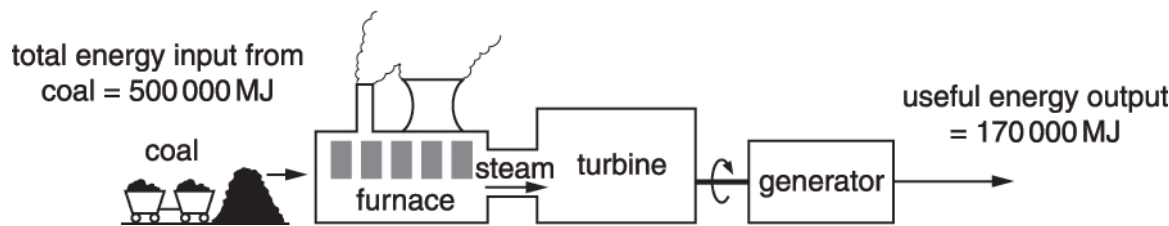
- (ii) The mean wind speed in this area is 5 m/s.

The maximum wind speed in this area is usually less than 15 m/s.

Explain, using data from the graph, why the people in the house **do not** normally need to worry about the noise from the turbine.

----- [2]

32(a) Electricity is generated in power stations.



Calculate the efficiency of this power station.

efficiency -----

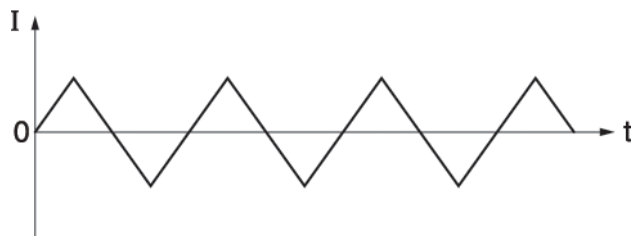
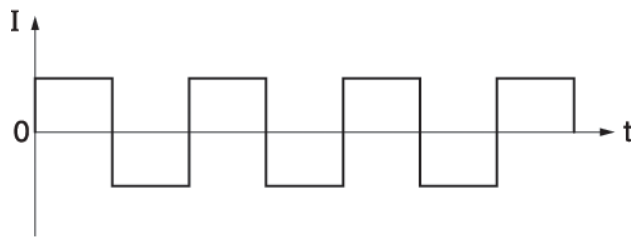
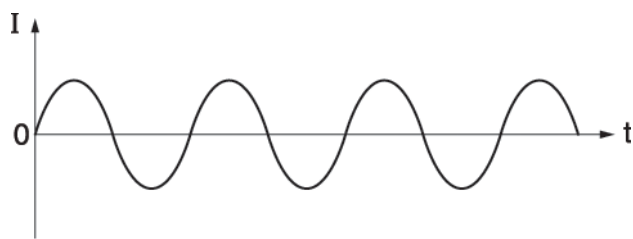
[2]

(b) The generator in the power station produces alternating current (AC).

(i) Name the type of current a battery produces.

-----[1]

(ii) Look at the three different current-time graphs.

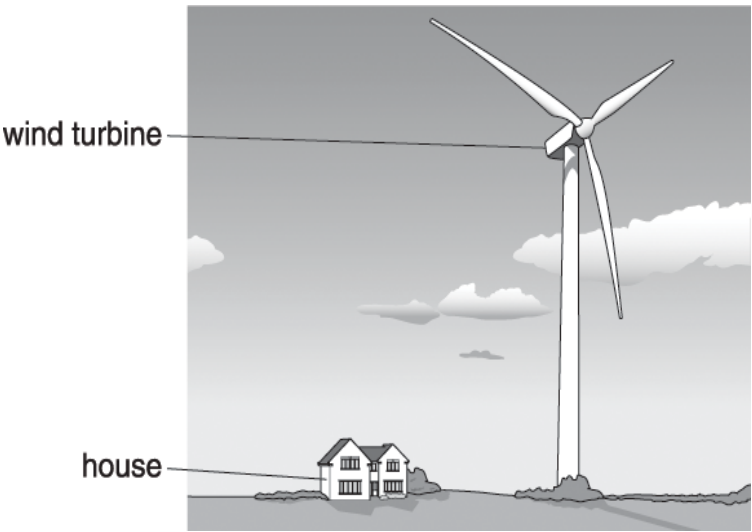


Describe why all the graphs show alternating currents.

----- [1]

33(a) The Sun's energy produces convection currents that cause wind.

Wind is used to drive turbines.



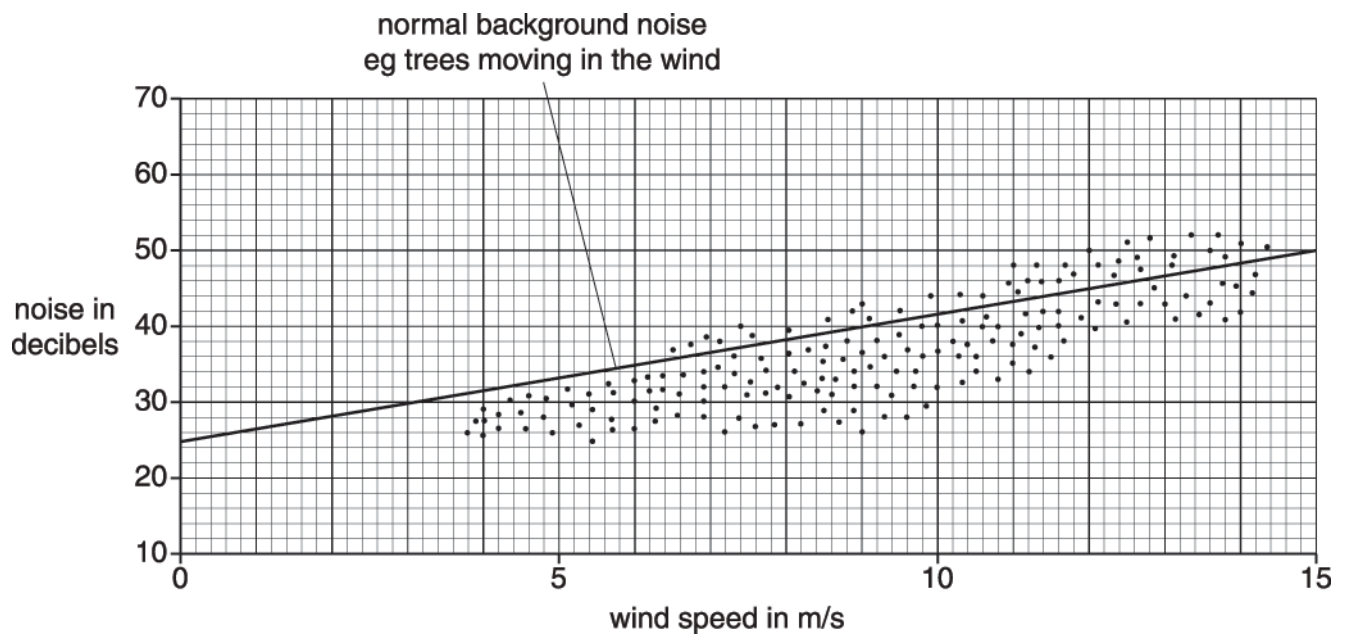
Describe the **advantages** of wind turbines compared to a conventional coal power station.

[2]

(b) The people in the house are concerned about noise from the wind turbine.

Look at the graph.

Each dot shows a measurement of the noise from the wind turbine.



- (i) Use the graph to describe how the wind turbine noise is affected by wind speed.

----- [1]

- (ii) The mean wind speed in this area is 5 m/s.

The maximum wind speed in this area is usually less than 15 m/s.

Explain, using data from the graph, why the people in the house **do not** normally need to worry about the noise from the turbine.

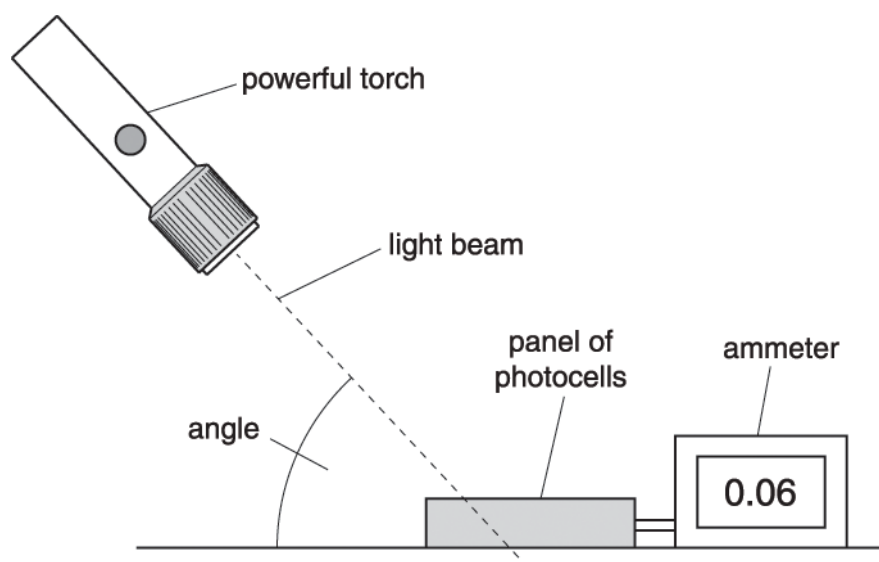
----- [2]

34(a) Energy can be collected from the Sun in many ways.

Photocells transfer the energy in sunlight into electricity.

Megan does an experiment with a panel of photocells in the laboratory.

Look at the diagram.



Megan shines the light on the photocell panel and records the current produced.

She changes the angle of the light beam and measures the current again.

Look at her results.

Angle of light beam in degrees	Current in mA
0	0.00
15	0.02
30	0.04
45	0.07
60	
75	0.16
90	0.22

Megan has lost her result for 60°. Estimate the current for an angle of 60°.

answer mA

[1]

(b) Describe how the current changes with increasing angle of light beam.

.....
 [1]

(c) Megan thinks she can get an output of 1.10 mA at 90° using 5 solar panels connected together.

Suggest why her prediction is sensible.

[1]

(d) The Sun in the UK is never at an angle of 90° to the Earth's surface.

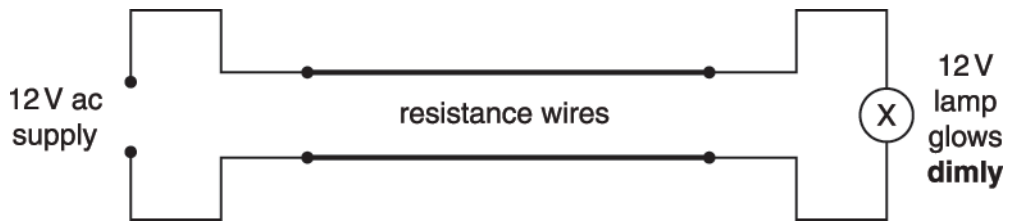
The Sun appears to move across the sky during the day.

Suggest how the output of a single solar panel could be increased.

[1]

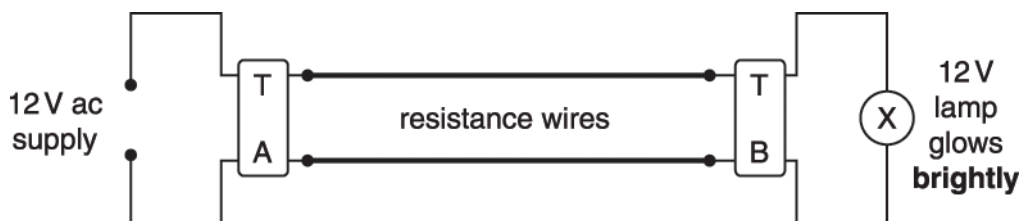
His teacher demonstrates how power loss can be reduced in a model transmission line.

She first sets up a system like this and the light glows dimly.



She adds two transformers (TA and TB) before and after the resistance wires.

The lamp now glows brightly.



Explain these observations, and how this type of arrangement is used to reduce energy losses in the National Grid.

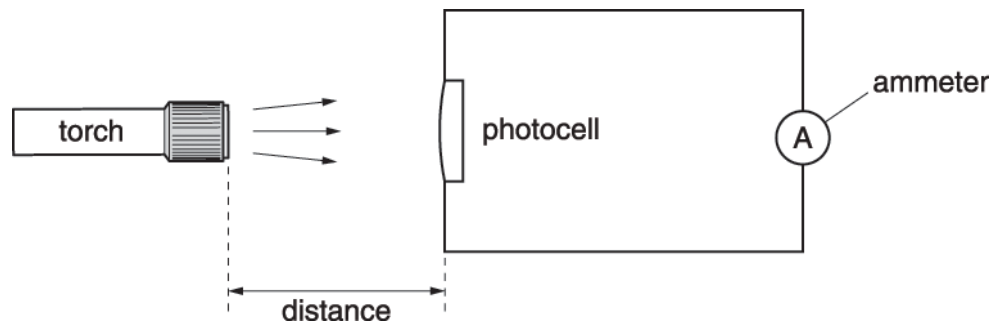


The quality of written communication will be assessed in your answer to this question.

[6]

36 John investigates the current produced by a photocell.

Look at the circuit he uses.



John moves the torch away from the photocell.

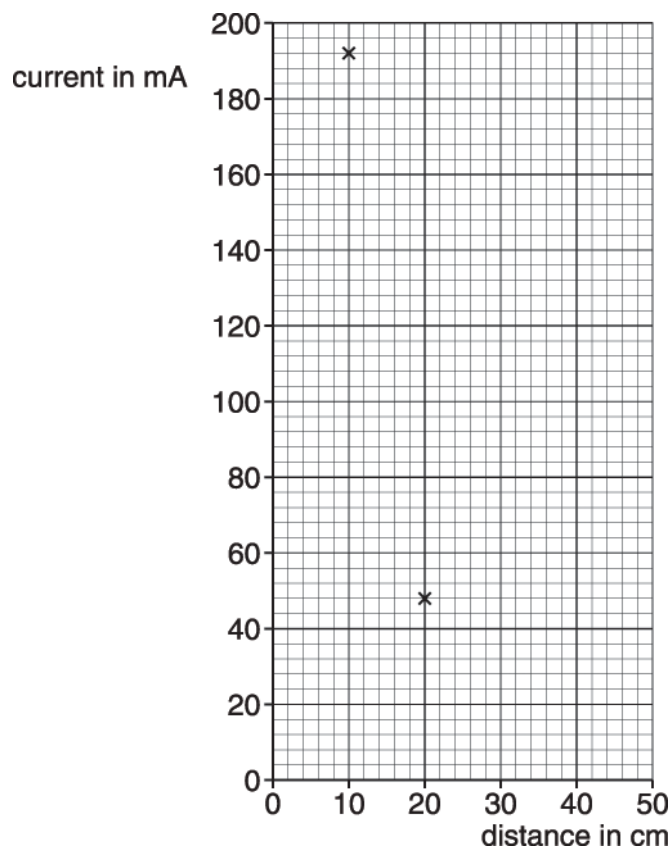
This changes the current through the ammeter.

Look at his results.

Distance between torch and photocell in cm	10	20	30	40	50
Current in mA	192	48		12	8

(i) Use the graph to help predict the current in mA for a distance of 30 cm.

The first two results in the table have been plotted for you.



Current for a distance of 30 cm = _____ mA

[2]

- (ii) Write a detailed conclusion about the relationship between the current and the distance between the torch and the photocell.

[2]

- (iii) Explain why this trend happens.

[1]

37(a) Nuclear power stations have benefits and risks.

Davinder is worried because he lives near a nuclear power station.

Write about **one risk** of living near a nuclear power station.

Explain how **this** risk is reduced for people living nearby.

[2]

(b) The nuclear power station produces electricity.

The electrical output of the power station is connected to transformers.

The outputs of these transformers are connected to the National Grid.

Why are these transformers used and how is this important for the National Grid?

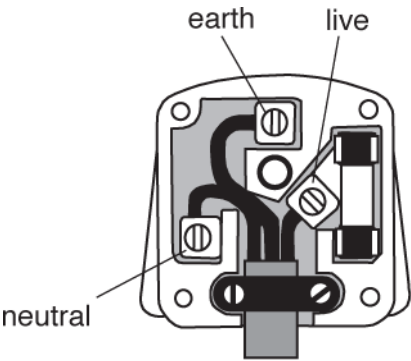
[3]

38 Transformers are used to **increase** the voltage of the electricity before it is transmitted to homes.

Explain why the voltage is increased.

[2]

39(a) Look at the diagram of a plug for an appliance.



Complete the table.

Wire	Colour	Function
earth	green / yellow	-----
live	-----	carries the high voltage
neutral	-----	completes the circuit

[3]

(b) Some appliances are double insulated.

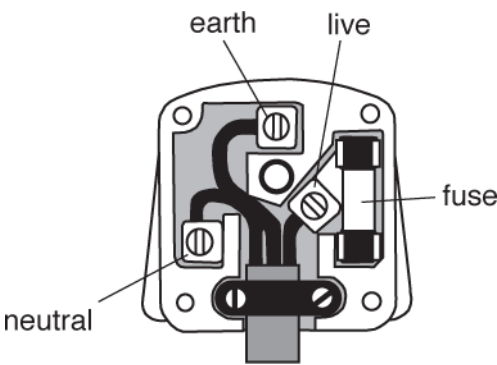
They have only two wires.

Write down the names of these two wires.

----- and -----

[1]

41 Look at the diagram of a plug for an appliance.



Describe the functions of the live, neutral and earth wires.

[3]

42(a) Electricity is produced using different methods.

Some methods produce direct current (DC) and some methods produce alternating current (AC).

Write down which of the following methods produce alternating current (AC) and which produce direct current (DC).

generator -----

photocell -----

battery -----

[2]

(b) A generator produces electricity.

Then the electricity is distributed to homes, factories and offices.

Describe the main stages in the production and distribution of electricity.

[3]

43 Ralph thinks that waste from nuclear power stations contributes to global warming.

Harry thinks deforestation contributes to global warming.

Explain who is correct.

[1]

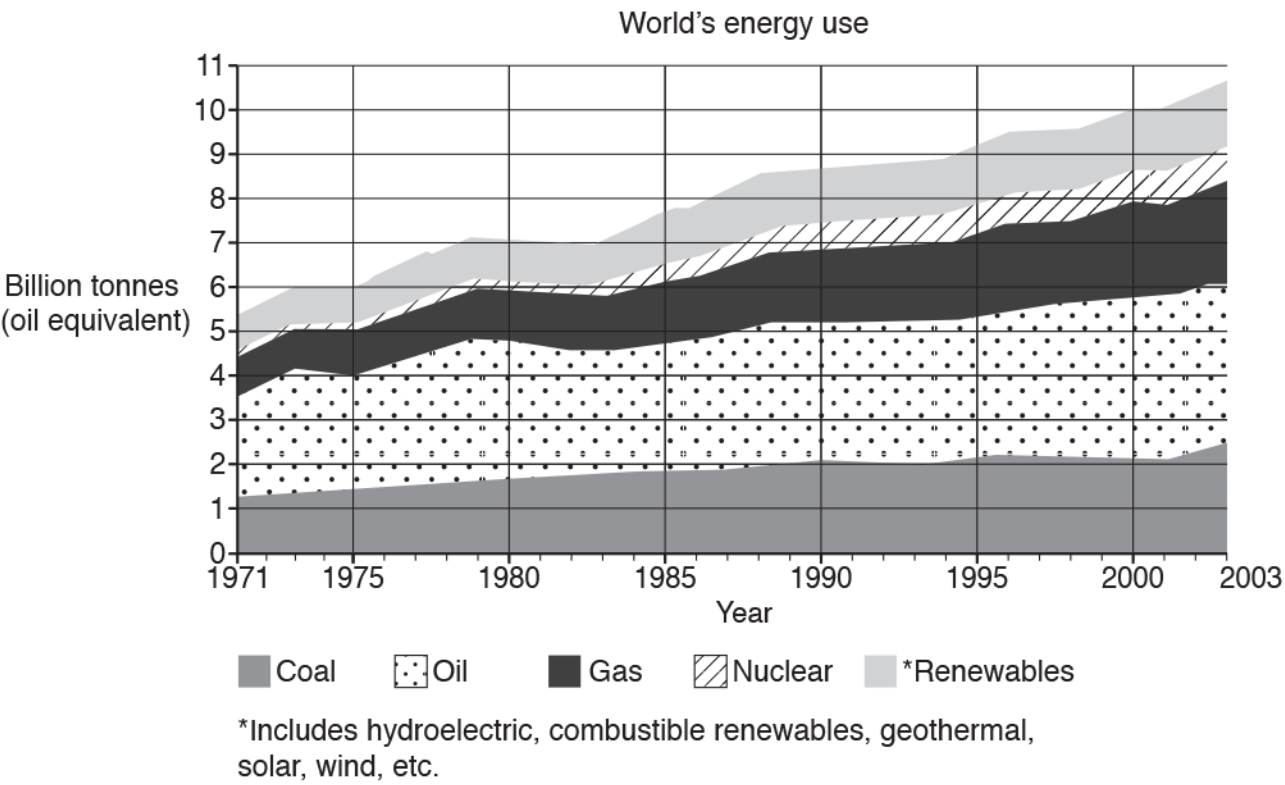
44 Which of the following correctly describes the domestic electricity supply in the UK?

- A 230 V a.c. at 50 Hz
- B 230 V a.c. at 60 Hz
- C 230 V d.c. at 50 Hz
- D 230 V d.c. at 60 Hz

Your answer [1]

45(a) The graph shows how the World's energy use has changed from the year 1971 to the year 2003.

It also shows the amount of different energy sources used.



(i) Approximately how much did the total World's energy use increase from the year 1971 to the year 2003?

Answer = ... billion tonnes (oil equivalent) [1]

(ii) Which energy source had the **greatest** use in the year 2003?

..... [1]

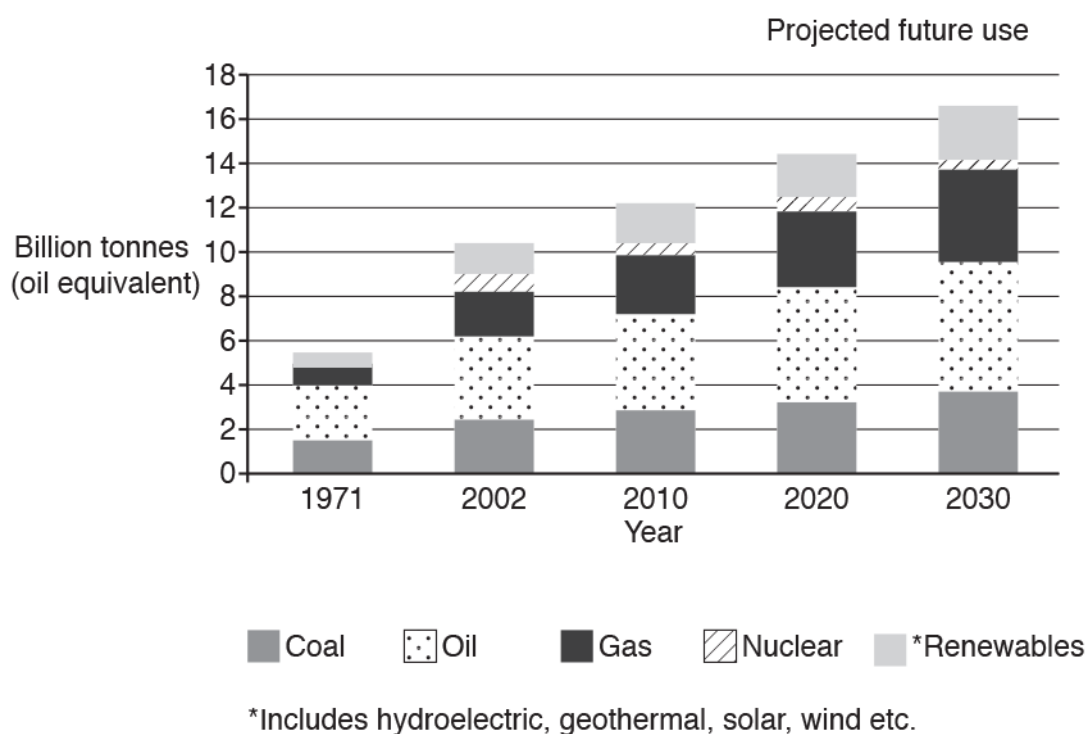
(iii) The total energy use in the year 2003 was 10.6 billion tonnes (oil equivalent).

Approximately what percentage of this amount was due to fossil fuel use?

Answer = ... % [2]

(b) Scientists are researching the World's energy use for the future.

The graph shows some of their research.



(i) The future demand for fossil fuels is expected to increase.

Give two reasons why scientists are worried about this increase in demand.

1

.....

2 -----

[2]

- (ii) In the UK the government is closing coal fired power stations and planning for new nuclear power stations to be built.

Suggest why the government wants more nuclear power stations.

----- [2]

(c) Power stations in the UK generate electricity at 25 kV a.c.

The voltage is then increased to 400 kV a.c. and distributed by power lines.

(i) Write down the full name of the device used to **increase** the voltage.

-----[1]

(ii) Why is it important to increase the voltage in these power lines?

-----[1]

(iii) The high voltages across the power lines are reduced to 230 V a.c. for use in the home.

A phone charger changes the 230 V a.c. to a 5 V d.c.

Explain the difference between d.c. and a.c.

-----[2]

(d) A domestic wind turbine has a power rating which varies from 1.0 kW to 3.0 kW.

(i) The domestic wind turbine has an electrical resistance of 23 Ω .

It generates a current of 11 A on a windy day.

Calculate the power output in kW of the turbine on this day.

Answer = _____ kW [4]

() Suggest why the manufacturer gives a range for the power rating of the wind turbine.

[1]

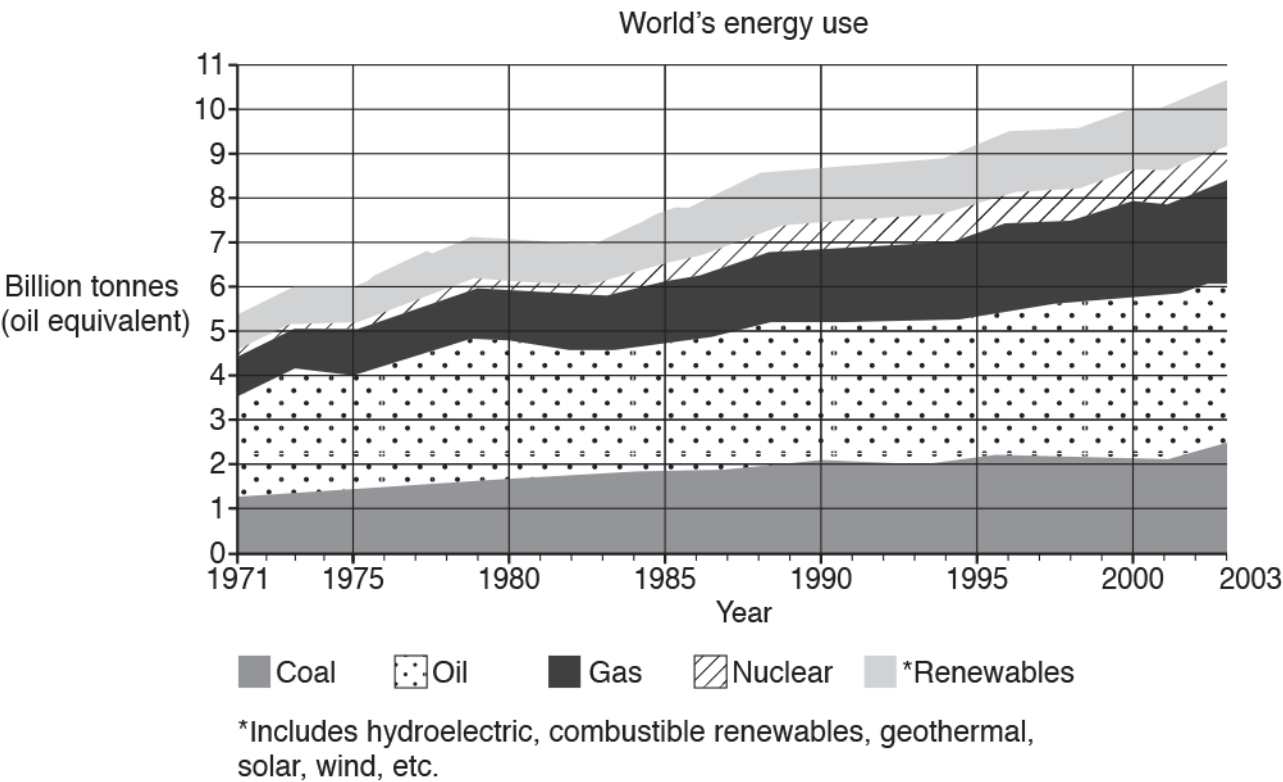
(i) Using just **one** domestic wind turbine may be an unreliable source of power for a house.

State a reason why.

[1]

46(a) The graph shows how the World's energy use has changed from the year 1971 to the year 2003.

It also shows the amount of different energy sources used.



(i) Approximately how much did the total World's energy use increase from the year 1971 to the year 2003?

Answer = ... billion tonnes (oil equivalent) [1]

(ii) Which energy source had the **greatest** use in the year 2003?

..... [1]

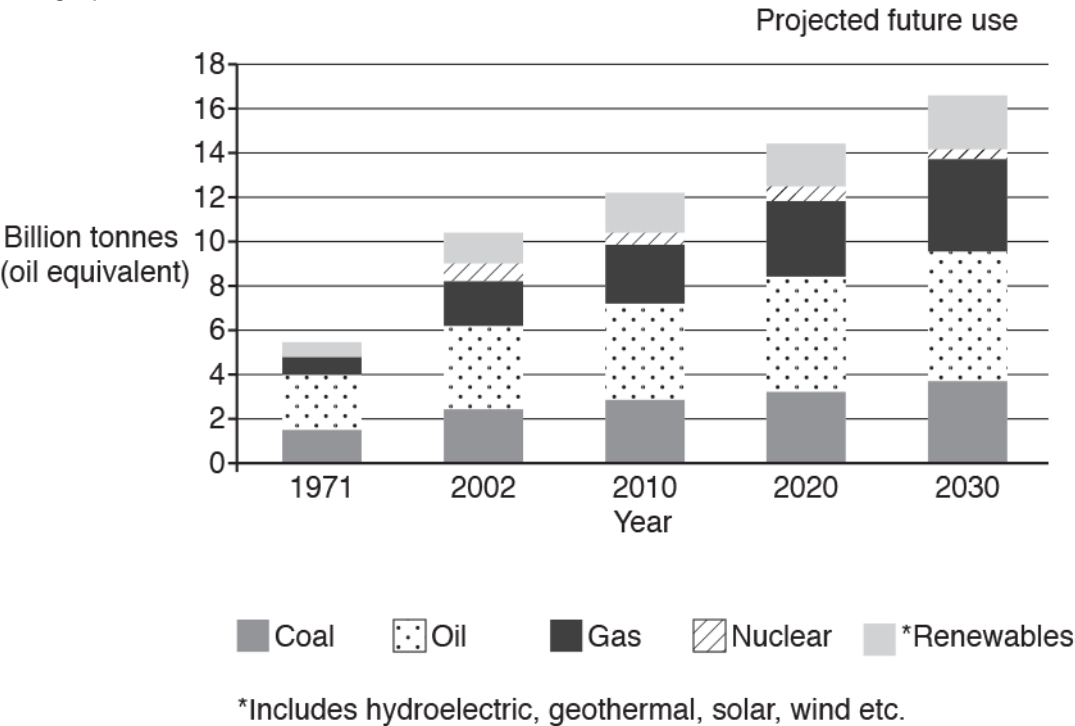
(iii) The total energy use in the year 2003 was 10.6 billion tonnes (oil equivalent).

Approximately what percentage of this amount was due to fossil fuel use?

Answer = ... % [2]

(b) Scientists are researching the World’s energy use for the future.

The graph shows some of their research.



(i) The future demand for fossil fuels is expected to increase.

Give two reasons why scientists are worried about this increase in demand.

1.
.....

2.

[2]

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Suggest why the government wants more nuclear power stations.

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- (c) Power stations in the UK generate electricity at 25 kV a.c.

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[1]

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Explain the difference between d.c. and a.c.

[2]

(d) A domestic wind turbine has a power rating which varies from 1.0 kW to 3.0 kW.

(i) The domestic wind turbine has an electrical resistance of 23 Ω .

It generates a current of 11 A on a windy day.

Calculate the **power** output in kW of the turbine on this day.

Answer = ----- kW [4]

(ii) Suggest why the manufacturer gives a range for the power rating of the wind turbine.

----- [1]

(iii) Using just **one** domestic wind turbine may be an unreliable source of power for a house.

State a reason why.

----- [1]

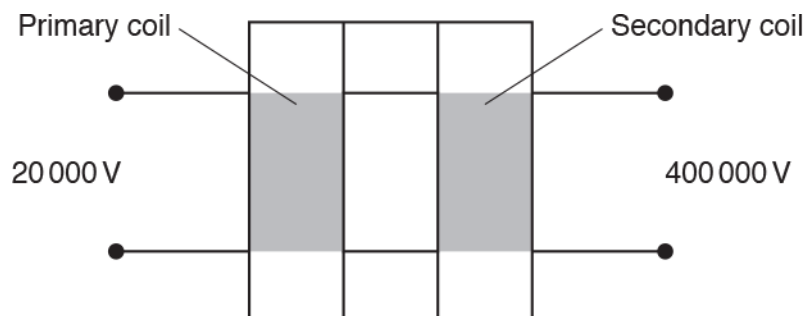
47 Which statement shows energy resources that are **all renewable**?

- A Bio-fuel, wind, hydro-electricity and tides.
- B Fossil fuels, bio-fuel, wind and hydro-electricity.
- C Fossil fuels, nuclear fuel, hydro-electricity and tides.
- D Nuclear fuel, bio-fuel, wind and tides.

Your answer

[1]

48 This is a diagram of a transformer used in the national grid.



Why is this transformer used in the national grid?

- A To decrease the power in the national grid by a factor of 20.
- B To decrease the power loss in the national grid by a factor of 400.
- C To increase the power in the national grid by a factor of 20.
- D To increase the power loss in the national grid by a factor of 400.

Your answer

[1]

49 Nuclear fission can be used as a power source to produce electricity.

Give one **advantage** and one **disadvantage** of using nuclear power to produce electricity.

advantage

disadvantage

[2]

50(a) Energy is transferred at high voltages in the national grid.

This house is near to a transmission line.



Explain why radio waves may be produced by the transmission line.

[2]

(b) Explain why it is more efficient to transfer energy at high voltages.

----- [2]

(c) The transmission line has a power loss of 6.156 kW.

Its resistance is 15.39 Ω .

Calculate the current in the transmission line.

Current = ... A [5]

51 Which statement describes the domestic electricity supply in the UK?

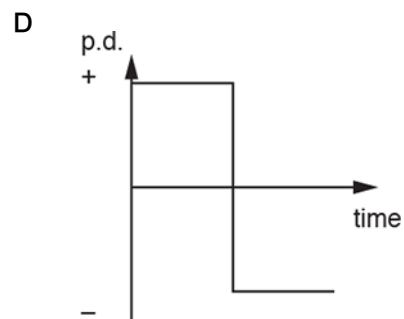
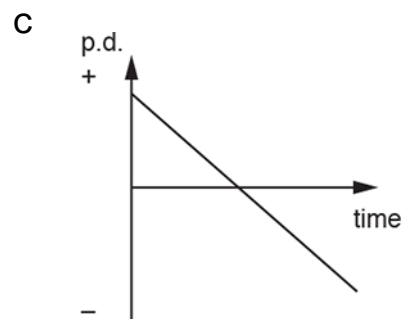
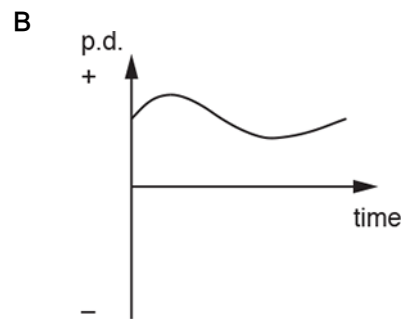
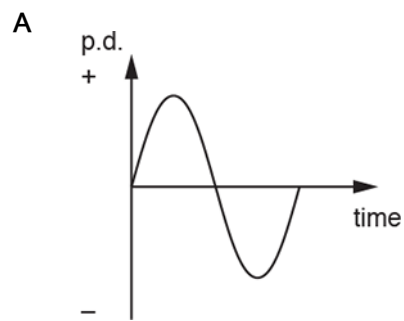
- A 50 V a.c. at 230 Hz
- B 50 V d.c. at 230 Hz
- C 230 V a.c. at 50 Hz
- D 230 V d.c. at 50 Hz

Your answer

[1]

52 Here are some graphs for the potential difference (p.d.) of four electrical supplies.

Which graph shows a direct voltage?



Your answer

[1]

53 Which row in the table correctly describes how the national grid transfers electrical energy efficiently?

	Voltage	Current	Reason
A	High	High	To increase heating in wires.
B	High	Low	To reduce heating in wires.
C	Low	High	To reduce heating in wires.
D	Low	Low	To reduce heating in wires.

Your answer

[1]

54 The table shows the current and potential difference (p.d.) for four different transformers.

Which row shows the correct data for a **step-up** transformer?

	Primary coil		Secondary coil	
	p.d. (V)	Current (A)	p.d. (V)	Current (A)
A	6	4	12	2
B	12	2	3	8
C	12	2	12	2
D	12	2	24	1.5

Your answer

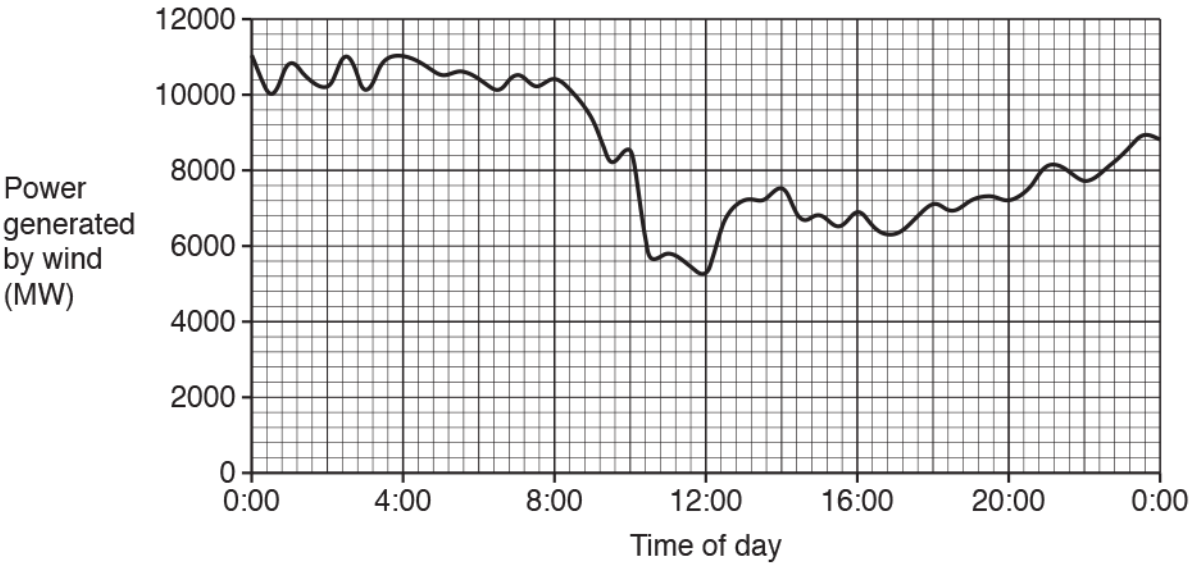
[1]

55 Some scientists say nuclear fission is renewable. Other scientists say it is non-renewable.

Suggest why the scientists disagree.

[1]

56 The graph shows how the power generated by the wind in the UK varied over one day.



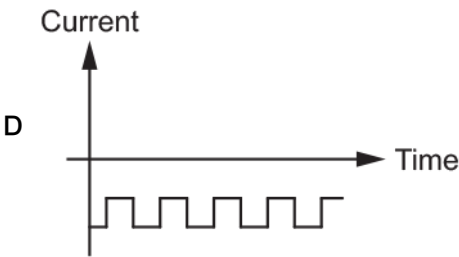
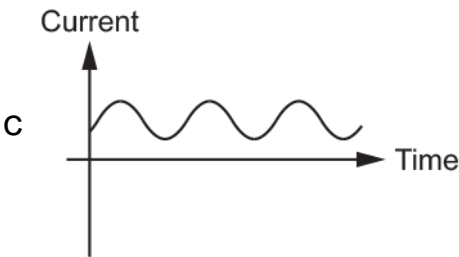
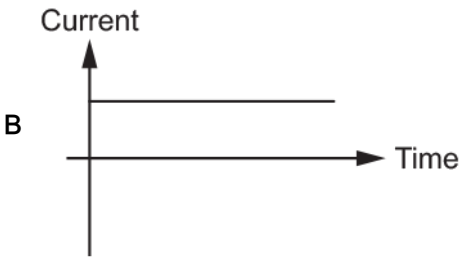
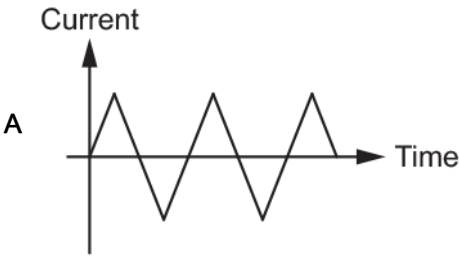
Which row in the table is correct?

	Maximum power generated (MW)	Reliability of wind power
A	5200	Reliable
B	5200	Unreliable
C	11 000	Reliable
D	11 000	Unreliable

Your answer

[1]

57 Which graph shows an alternating current (a.c.)?



Your answer

[1]

(i) A projector is connected to the mains power supply. The projector has an earth wire.

State the potential difference between the earth wire and the live wire in normal use.

Potential difference = ... V [1]

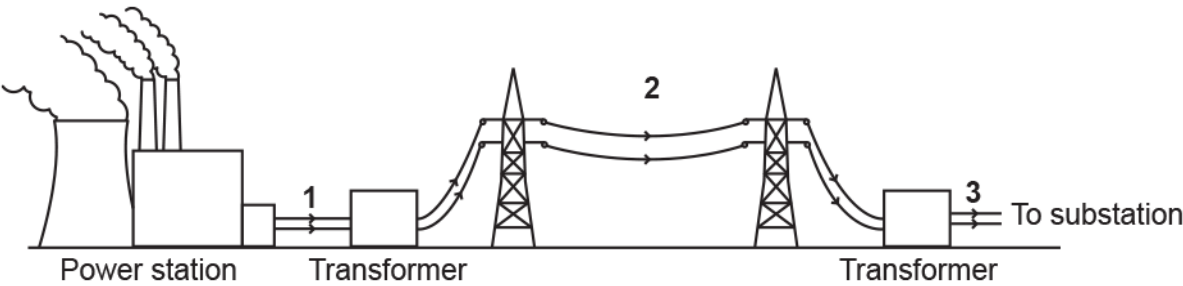
(ii) A projector with a plastic case does not need an earth wire.

A projector with a metal case needs an earth wire.

Explain why.

-----[2]

59 The diagram shows a simplified version of the national grid.



The potential difference (p.d.) is different at each point in the national grid.

Which row in the table is correct?

	p.d. at position 1 (V)	p.d. at position 2 (V)	p.d. at position 3 (V)
A	230	5 000	11 000
B	25 000	450 000	11 000
C	450 000	150	230
D	450 000	5 000	230

Your answer

[1]

60 A projector is used to create a larger image of an object.

(i) The projector is connected to the mains power supply. The projector has an earth wire.

State the potential difference between the earth wire and the live wire in normal use.

Potential difference = ...V [1]

(ii) A projector with a plastic case does not need an earth wire.
A projector with a metal case needs an earth wire.

Explain why.

-----[2]

61 * The UK generates some of its electrical power from wind turbines.

Fig. 18.1 shows the total electrical power generated by wind turbines in the UK.

The graph is for a single day in December which had very strong winds.

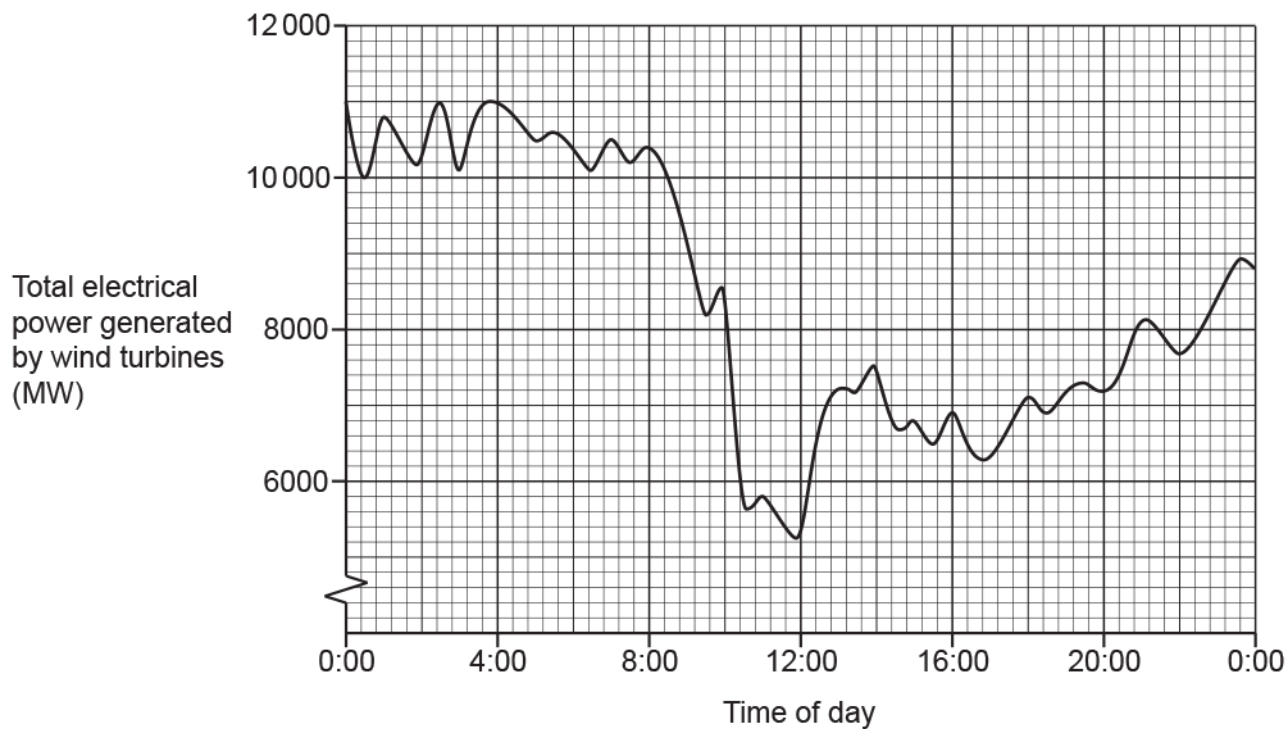


Fig. 18.1

Fig. 18.2 shows the total demand for electrical power in the UK on the same day.

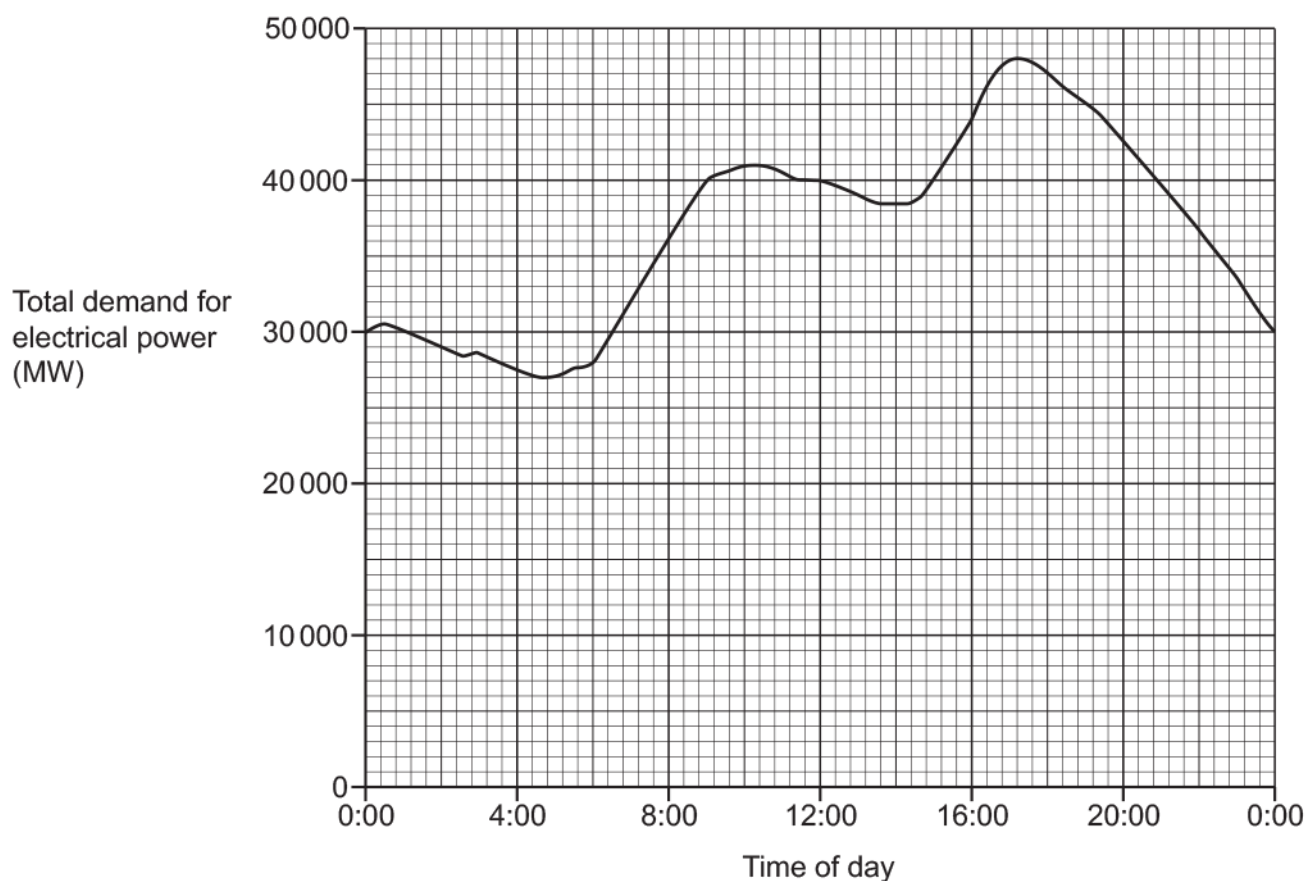


Fig. 18.2

Some experts believe the UK should generate most of its electrical power from wind.

Evaluate the advantages and disadvantages of this idea.

Use the graphs in Fig. 18.1 and Fig. 18.2 and your own ideas about wind turbines to support your answer.

[6]

62 Water can be heated using a 12 V heater.

A transformer is used to change a 120 V supply into 12 V.

The current in the secondary coil is 9.0 A.

Calculate the current in the primary coil.

Use an equation from the data sheet.

Current = ... A [2]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance														
1			A	1															
			Total	1															
2			C	1															
			Total	1															
3	a		more can be grown / AW (1)	1															
	b		<table><thead><tr><th>Fuel</th><th>Type</th></tr></thead><tbody><tr><td>Wood</td><td>renewable</td></tr><tr><td>Plant and vegetable oils</td><td>renewable</td></tr><tr><td>Peat</td><td>non-renewable</td></tr><tr><td>Coal</td><td>Renewable (x) (1)</td></tr><tr><td>North Sea gas</td><td>non-renewable</td></tr><tr><td>Uranium</td><td>renewable (x) (1)</td></tr></tbody></table>	Fuel	Type	Wood	renewable	Plant and vegetable oils	renewable	Peat	non-renewable	Coal	Renewable (x) (1)	North Sea gas	non-renewable	Uranium	renewable (x) (1)	2	ALLOW the answer to be checked on the fuel side.
Fuel	Type																		
Wood	renewable																		
Plant and vegetable oils	renewable																		
Peat	non-renewable																		
Coal	Renewable (x) (1)																		
North Sea gas	non-renewable																		
Uranium	renewable (x) (1)																		
	c		Increases output potential difference (1)	1															
	d		<table><thead><tr><th>Wire</th><th>Colour</th><th>Function</th></tr></thead><tbody><tr><td>Live</td><td>blue (1)</td><td>Completes the circuit</td></tr><tr><td>Earth</td><td>brown</td><td>safety wire (1)</td></tr><tr><td>Neutral</td><td>yellow and green</td><td>has a high potential</td></tr></tbody></table> Correct matching of wires to colours (1) Correct matching of colours to functions (1)	Wire	Colour	Function	Live	blue (1)	Completes the circuit	Earth	brown	safety wire (1)	Neutral	yellow and green	has a high potential	4			
Wire	Colour	Function																	
Live	blue (1)	Completes the circuit																	
Earth	brown	safety wire (1)																	
Neutral	yellow and green	has a high potential																	
			Total	8															
4			D	1															
			Total	1															
5			A	1															
			Total	1															
6		i	Simple use of $P = V \times I$ / idea of ratios using transformer equations (1)	2	ALLOW current reduced (1)														
			Current reduced by 16 times (1)																

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Very large decrease in power loss (1) Power loss is related to the square of the current / AW (1)	2	
			Total	4	
7		i	1 solar (1) 2 bio diesel (1)	2	one mark for each correct answer, either order for either mark allow electric or battery [1] ethanol or bio-ethanol or bio-fuel for bio diesel [1] <u>Examiner's Comments</u> The majority of candidates correctly gave solar and electricity as alternatives to fossil fuels.
		ii	any one from idea that we don't get enough sunlight to power a car (1) bio-fuels are difficult to find / few garages sell bio-fuel (1) few charging points for battery / limited range for battery / batteries take too long to charge (1)	1	<u>Examiner's Comments</u> The most common one not thought to be suitable was solar with a reason that we do not get much sun in the UK.
			Total	3	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
8	Level 3: (5–6 marks) Answer shows how both ideas can be maximised AND how this will help the environment. Quality of written communication does not impede communication of the science at this level. Level 2: (3–4 marks) Answer shows how both ideas can be used OR one idea used and maximised AND how this will help the environment. Quality of written communication partly impedes communication of the science at this level. Level 1: (1–2 marks) Answer shows how one idea can be used OR how it helps the environment. Quality of written communication impedes communication of the science at this level. Level 0: (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.	6	This question is targeted up to grade C Indicative scientific points may include: maximise output: • large area windows / large area conservatory / large area panels • windows / panels face Sun or south • panel tracks Sun • use most efficient photocells possible helping environment: • less fossil fuels needed • no polluting waste • less CO₂ or SO₂ or acid rain • less nuclear fuel used using the ideas: • photocells / solar panels need sunlight • photocells convert light to electricity • photocells / solar panels on roof / AW • windows let in radiation / AW • heat (energy) trapped in house • passive heating of water possible Use the L1, L2, L3 annotations in Scoris; do not use ticks. <u>Examiner's Comments</u> This was a 6-mark question targeted at up to grade C. The question asked about 4 things: passive solar heating, photo cells, how to maximise the energy collected and how this helps the environment. The majority of candidates made relevant statements about using photo cells and several explained that the output could be maximised by putting them on the south side of a building and increasing the area. A few candidates added that there would be reduced use of fossil fuels at power stations. It was rare to see any comment

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					about passive solar heating.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
9	a		any two for one mark coal / oil / gas [1]	1	two fossil fuels required in either order for one mark ignore peat allow crude oil but not incorrect fractions eg. petrol <u>Examiner's Comments</u> Most candidates were able to name two fossil fuels used in power stations, although a significant number of candidates thought that petrol was used in power stations.
	b		any one from wood (chips) [1] straw [1] manure [1] biomass [1] methane [1]	1	ignore nuclear fuel allow household waste [1] <u>Examiner's Comments</u> Very few candidates correctly named a renewable fuel used in power stations. The majority gave renewable energy sources such as wind and solar.
	c		for one mark (.... power lines called the) national grid [1] any two for one mark (.... to consumers such as) homes / factories / offices / farms / schools / buildings / shops / etc [1]	2	allow electricity grid / electrical grid / distribution grid [1] two consumers required in either order for one mark <u>Examiner's Comments</u> Almost half the candidates knew that the system of power lines is called the National Grid but the majority knew that it connected to consumers such as homes or factories. Examiners credited any correct consumer building.
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10			lowers current [1] reduces heating effect (in wires) [1]	2	Ignore less energy is lost. Allow less heat loss [1] Allow correct use of I^2R Examiner's Comments About a third stated that the current was lower (at high voltages) [1] so that less heat was wasted [1]. Some answered well using I^2R to illustrate the marking points [2].
			Total	2	
11		i	4 [2] but if answer is incorrect $\frac{7300}{5 \times 365} \quad [1]$	2	Examiner's Comments Most calculated the family size to be 4 [1]. A few candidates however, gave wrong (and unreasonable answers) of family sizes into the many thousands. If these had re-read the question and judged if their answers were reasonable (for the size of one family) then they may have re-checked their arithmetic and gained the marks.
		ii	(idea of) more people in UK or less people in Belgium [1]	1	allow different populations [1] allow justified examples e.g. industry use in UK is higher [1] Belgium uses more gas / wastes less energy [1] (idea that) Belgium uses more efficient appliances (than the UK) [1] Eg. Belgium uses more LEDs than the UK [1] Allow other sources of power used. Eg solar heating of water [1] Examiner's Comments This part of the question was common with the foundation paper (B752-01). Most referred correctly to the lower population in Belgium [1].
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
12			risk of electrocution / (severe) shock / death [1] benefit reduces power / heat / energy loss [1]	2	NOT merely (causes more) damage / more dangerous ignore heating of wires as a risk allow other sensible risks if qualified allow conserves fuel resources / reduces costs for the power company / more efficient [1] ignore more power transmitted / lower current Examiner's Comments Most answers referred to less energy wasted or more efficient for [1] mark. Others also added the increased risk of electrocution [1]. Some were vague by saying high voltage was dangerous or too high a voltage for the home.
			Total	2	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
13	[Level 3] Explains all three from: -why the plug only needs two wires -explains why the plug needs a fuse -why the fuse is 13A (rather than 3A). Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Explains two from: -why the plug only needs two wires -explains why the plug needs a fuse -why the fuse is 13A (rather than 3A). Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Explains one from: -why the plug only needs two wires -explains why the plug needs a fuse -why the fuse is 13A (rather than 3A). Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to B. Description about why the 13A fuse is important: • 13 A fuse is above the normal working current for the hairdryer / the normal working current of the hair dryer is less than 13 A • 3A fuse would blow under normal use as more current is required by hairdryer • correct explanation using power = voltage × current to choose the correct fuse Why a fuse is needed: • idea that fuse melts if too much current flows • safety reason explained e.g. a small increase in the normal current will cause the fuse to melt / blow so very high current due to a fault will not happen. Eg. too large a current causes the fuse (wire) to melt / blow • reduces the risk of fire (if the hair dryer develops a fault) eg. prevents the flex / hair dryer overheating / causing a fire Why the plug only needs two wires: • earth wire not needed • only needs live and neutral wires • the hair dryer is double insulated / has a plastic case / has no touchable metal parts • the plastic case is an insulator / non conductor / cannot become live Use the L1, L2, L3 annotations if needed; do not use ticks. Examiner's Comments This level of response 6-mark question on

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					household plugs and fuses was quite well answered. It was targeted at grades D up to B. It gave a full spread of marks with just over half of answers scoring 4 or more marks. Weaker answers that the two wires required were earth and live. Other weak answers often only said that the earth wire was not needed but failed to develop the answer further. There were some good answers in terms of double insulation and the plastic insulating case being unable to become live. There were some misconceptions such as the wire is double insulated. Also some poorly communicated phrases such as the fuse breaks or goes (rather than melts or blows) were commonplace. Also fuses blowing with too much voltage was quite common. Only a few mentioned fire risk. Candidates often said that the current was below 13A but did not clearly say that current was (or needed to be) above 3A. Voltage, current and power were used interchangeably and some candidates were confused over a fuse heating up (and melting) and the hairdryer itself heating up. However, the question attracted many answers which were worthy and contained good physics.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
14		i	140 (kWh) [2] but if answer is incorrect 5 × 4 × 7 scores [1]	2	also if answer is incorrect or incomplete then as an alternative allow: 28 × 5 or 20 × 7 [1] Examiner's Comments This data question on electrical energy usage across Europe was answered well across the full range of candidates. Almost all calculated energy usage in kWh
		ii	Austria [1] Germany [1]	2	any order if more than two countries then deduct [1] for each incorrect response e.g. Austria, Germany, UK [1] Austria, UK [1] Austria , UK, Sweden [0] Examiner's Comments This data question on electrical energy usage across Europe was answered well across the full range of candidates. Almost all correctly selected Austria and Germany. A very small number gave more than 2 countries and so were penalised for doing so.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	others will be using more than 20.5kWh /AW [1]	1	allow some will use more and some will use less [1] allow it is an average so people use more or less [1] ignore it is just an average ignore people do not use the same Examiner's Comments This data question on electrical energy usage across Europe was answered well across the full range of candidates. Most could not explain that there will be some users above as well as below the mean.
		iv	(idea of) more people in UK or less people in Belgium [1]	1	allow different populations [1] allow justified examples e.g. industry use in UK is higher [1] Belgium uses more gas / wastes less energy [1] (idea that) Belgium uses more efficient appliances (than the UK) [1] Eg. Belgium uses more LEDs than the UK [1] Allow other sources of power used. Eg solar heating of water [1] Examiner's Comments This data question on electrical energy usage across Europe was answered well across the full range of candidates. Most scored 1 for the idea that Belgium had a lower population
			Total	6	
15			B and C [1] (idea that) the output voltage is higher than the input voltage / ora [1]	1	both required in either order Examiner's Comments Most candidates could identify errors in a table of step up and step down transformers. Only the lowest ability candidates found this question challenging.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
16			box next to 50Hz ticked [1]	1	allow any indication of the correct answer more than one box ticked = 0 marks Examiner's Comments This question on ac and half wave rectification produced the best and worst responses to questions in the whole paper. Most could recall that UK mains is 50Hz.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
17			Level 3: (5 – 6 marks) Correct statement regarding acceleration in vertical OR horizontal direction AND compares trajectories or relative speeds. Quality of written communication does not impede communication of the science at this level. Level 2: (3 – 4 marks) Answer compares the speeds of marbles with a reason AND compares the trajectories Quality of written communication partly impedes communication of the science at this level. Level 1: (1 – 2 marks) Answer compares the speeds of marbles OR describes the trajectories simply. Quality of written communication impedes communication of the science at this level. Level 0: (0 marks) Insufficient or irrelevant science. Answer not worthy of credit	6	This question is targeted up to grade C To reach Level 3 a correct statement regarding acceleration in at least one direction is needed Indicative scientific points may include: Describing the accelerations • no horizontal acceleration • there is constant vertical acceleration Comparing trajectories • paths are parabolic • path V3 is more curved as it is moving faster (horizontally) Comparing speeds • V1 slowest / V3 fastest / AW • because V3 travels furthest Simple description of trajectory • curved paths Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This 6 mark level of response question trajectories was targeted at grade C. This question gave a good range of marks and discriminated well across the candidature. Most could compare the different speeds of the object in each trajectory. Higher ability candidates often achieved a Level 2 by describing that the faster object travelled further or by describing the parabolic shape. Responses that could describe accurately the horizontal and vertical accelerations of the projectile were very rare.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
18		i	any one from both heat water / both produce steam [1] both have turbines [1] both use a generator (to generate electricity) [1]	1	ignore nuclear 'fuel burns' ignore merely 'different fuels used' ignore just generate electricity Examiner's Comments This question on electricity generation was quite well answered across the full range of candidates. Most scored at least 2 out of 4 marks. Most could identify a similarity between coal fired and nuclear power station.
		ii	any one from (nuclear power stations) use uranium [1] (nuclear power stations) use a nuclear reaction / coal burns but nuclear does not [1] (nuclear power stations) have a reactor / (nuclear power stations) do not have a furnace [1] (nuclear power stations) do not produce (named) greenhouse gases [1] (nuclear power stations) produce radioactive waste [1]	1	allow plutonium or thorium [1] ignore just 'different fuel' Examiner's Comments This question on electricity generation was quite well answered across the full range of candidates. Most scored at least 2 out of 4 marks. Only higher ability candidates tended to describe differences between the two types
			Total	2	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
19	(Level 3) Identifies the correct colour coding AND describes why a 13A fuse is important AND how the fuse operates. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Must have at least 2 from Identifies the correct colour coding OR recognises that no earth wire is required OR describes why a 13A fuse is important. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Identifies the correct colour coding OR recognises that no earth wire is required OR basic understanding of a fuse. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C. Description about why the 13A fuse is important: • prevents further damage to hairdryer • 13A fuse is just above the normal working current for the hairdryer • a smaller fuse would blow Description about how the fuse operates: • currents above 13A cause the fuse to melt • this prevents current flow • disconnects from mains voltage Basic description of fuse • stops overloading • reduces risk of fire Recognises that no earth wire is required: • only two wires drawn on diagram / only two wires are needed • written indication that no earth wire is required e.g. no need to earth / no green-yellow wire Identification of the colour coding: • live is brown • neutral is blue Use the L1, L2, L3 annotations in scoris. Do not use ticks. This 6 mark level of response question describing how to wire a plug for a double insulated hairdryer and to describe the importance of a fuse was not well answered. The question was targeted up to grade C. Many could recall colour coding to reach Level 1, some recognised that the earth wire was not needed and only the highest ability candidates could accurately describe the need for a 13 Amp fuse. This

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					question was surprisingly challenging as the material is very familiar but the move to a less structured question proved to be challenging this year.
			Total	6	
20			(step down) transformer [1]	1	ignore type of transformer <u>Examiner's Comments</u> Only about 25% of candidates correctly identified the device that reduces mains voltage as a transformer.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance																					
21	a		circuit contains diode (1) then only allows current in one direction / AW (1) but diode connected wrong way in circuit (2)	2	allow diode labelled on diagram allow the  is the wrong way round (1) allow cells / battery wrong way round (1) Examiner's Comments Very few candidates identified the diode or knew its purpose. Many thought that the diode was a NOT gate. Some misunderstood the symbol for a battery as providing a gap in the complete circuit.																					
	b		idea of half wave rectification / current only flows half of the time / current only flows part of the time (1)	1	allow the current is changing direction / the current is going back and forth ignore just the current is alternating / it is an alternating current ignore the current changes Examiner's Comments Almost no candidates had any understanding of the role of the diode in half wave rectification.																					
			Total	3																						
22			<table><tr><th>step up</th><th>step down</th><th>isolating</th></tr><tr><td>(✓)</td><td></td><td></td></tr><tr><td></td><td>✓</td><td></td></tr><tr><td></td><td></td><td>✓</td></tr><tr><td></td><td>✓</td><td></td></tr><tr><td>✓</td><td></td><td></td></tr><tr><td colspan="3">(2)</td></tr></table>	step up	step down	isolating	(✓)				✓				✓		✓		✓			(2)			2	all correct (2) 2 or 3 correct (1) Examiner's Comments Most candidates showed a good grasp of the structure of different types of transformer to gain both marks.
step up	step down	isolating																								
(✓)																										
	✓																									
		✓																								
	✓																									
✓																										
(2)																										
			Total	2																						

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
23			s t e a u r a n i u m a d i o a c t i v e	2	answers in crossword take precedent but if crossword blank allow answers next to the clues 1 or 2 correct = 1 mark 3 correct = 2 marks Examiner's Comments Most candidates achieved at least 1 mark and about a third achieved 2 marks. Lack of knowledge of uranium as nuclear fuel and that nuclear waste was recycled (rather than radioactive) frequently prevented the gaining of 2 marks.
			(2)	2	
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
24	a	i	iron / soft iron / laminated (core) secondary (coil) primary (coil) step-down	2	4 correct = 2 marks 2 or 3 correct = 1 mark Examiner's Comments The labelling of the transformer was done correctly by about 50%. Common incorrect responses were 'inner' core and step-up transformer.
		ii	375 (V) (2) but if calculation incorrect $\frac{10\,000}{\text{output}} = \frac{4000}{150} \text{ (1)}$	2	Allow 374.5 to 376 [2] $\left[\frac{4000}{150} \right] = 26.6(67) / 26.7 \text{ [1]}$ allow correct versions of this substituted equation e.g. output × 4000 = 10 000 × 150 (1) Examiner's Comments The calculation was better answered than in previous years. Many got full marks here with partial answers (26.6 – missing the final step) gaining one mark.
	b		AC produces a changing magnetic field (1) a changing magnetic field produces a changing voltage / current in the coil (1) if no marks scored electromagnetic induction (only happens with AC) [1]	2	allow DC does not produce a changing magnetic field (1) allow idea of changing magnetic field needed for any voltage / current to be induced (1) Examiner's Comments The question asked candidates to explain why transformers require AC. It proved challenging for many who failed to mention the changing magnetic field.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
25			any two from transformers can be used to change voltage or increase voltage or decrease voltage (1) 110 000 V is dangerous or make the voltage safer for people (in their homes) (1) less power loss (at high voltages) or more efficient (at high voltages) (1)	2	allow idea of a step up transformer for increasing voltage from power station to power lines (1) allow idea of a step down transformer for decreasing voltage from power lines to house for safety (1) allow higher level answers e.g. increases the efficiency because it lowers the current (2) <u>Examiner's Comments</u> ??Very few candidates could explain why transformers improve electricity transfer. Frequently answers lacked clarity and made the most vague references to increased safety (and on many occasions preventing appliances from blowing up).
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
26			yes / no (no mark) any three from idea that CO₂ produced when biofuel made (1) carbon dioxide is given out (when fuel burns) (1) (biofuel is made from) plants / animals / living things (1) (plants) photosynthesise [1] carbon neutral (1)	3	Allow trees [1] but plants photosynthesise (2) allow plants take in carbon dioxide when they grow (2) Award marks for combining marking points: eg. 'CO₂ given out (by fuel) compensated by photosynthesis [2] Eg. carbon dioxide given out when fuel burns = carbon dioxide taken in by plants [3] <u>Examiner's Comments</u> The first question on section C module P1 was about speed and has 10 marks in total. There were some excellent responses about biofuels, which covered all marking points showing a secure understanding of the issues and processes. One common misconception though with weaker answers was that 'biofuels do not produce CO₂ when burned'. Concise answers such as 'plants take in CO₂ when growing and give out CO₂ when burned shows that they are carbon neutral' were quite common.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
27	a		Idea that: water heated / steam is produced / fuels release heat / AW (1)	1	allow Heat energy is used (to produce electricity) (1) ignore burning Heat unqualified = 0 fuel is heated = 0 Examiner's Comments Most candidates understood that a thermal power station involved heat.
	b		renewable energy (1) less polluting gases (1) fossil fuels finite (1)	1	allow reduces CO₂ output / greenhouse gases (1) allow fossil fuels are running out (1) allow no fuel costs (1) not just environmentally friendly Examiner's Comments Most candidates produced the standard answers of renewable energy, less polluting gases, less use of fossil fuels.
			Total	2	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
28		Level 3: (5 – 6 marks) fuel power station AND pumped storage system linked together with demand Quality of written communication does not impede communication of the science at this level. Level 2: (3 – 4 marks) fuel power station OR pumped storage system linked together with demand Quality of written communication partly impedes communication of the science at this level. Level 1: (1 – 2 marks) sensible comment about the system Quality of written communication impedes communication of the science at this level. Level 0: (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.	6	This question is targeted up to grade A* Indicative scientific points may include: fuel power station (on own) difficulty in stopping and starting fuel power stations generates electricity all (or most of) the time at a steady rate cannot store electricity pumped storage system (together with fuel power station) with pump storage system it can store surplus energy energy stored off peak or when demand is low / in the middle of the night. with pump storage system it can generate electricity when needed water released when extra energy needed at high or peak demand changes in demand can cope with surges in demand (idea that there is) a (relatively fast) response time to demand less likely to result in power cuts (when demand is greater than steady supply) (idea that) energy not 'wasted' so cheaper for both consumers and producers saves the need to redistribute energy using the national Grid Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This question ,worth six marks, was about a pumped storage system. There was some confusion as to how this system worked even though the basic operation was given in the question. Weaker candidates thought it replaced conventional power stations when demand was low. The majority of candidates, however, reached level 2 with about 10% going on to reach level 3. Candidates were

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					able to comment generally on the system and link either the power station to the pumped storage system to demand. Few candidates linked the two systems together: when demand for electricity was low, energy was stored in a high level reservoir and when demand was high, this stored water was used to generate electricity.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
29	a		Risk max 1 radiation leak / leak of nuclear material / leak of nuclear waste (1) power station / reactor may get damaged / attacked by terrorist / earthquake (1) radiation sickness / poisoning (1) how the risk is reduced / managed max 1 monitor people (for contamination) (1) monitor radiation around the nuclear power station (1) safe storage or disposal of nuclear materials (1) idea of better control of reactor (1) better shielding against radiation loss (1) have good shut down / emergency procedures (1) extra protection if in earthquake risk area (1) better security at nuclear power station (1)	2	ignore power stations emit radiation allow correct examples such as radioactive materials stored (deep) underground / encased in (thick) concrete / lead (1) allow correct examples such as surround the reactor with (thick) concrete walls (1) Examiner's Comments This HSW question focussed on the risks of nuclear power generation and how to reduce these risks. Most candidates mistakenly thought that nuclear power stations continuously emit dangerous levels of radiation. Better answers described 'leaks' or 'reactor problems that allowed radiation to escape'. Management of this risk such as creating a no-go area in such an emergency gained 1. Nuclear waste being buried in glass deep underground was also a common correct answer.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		idea of voltage change (1) but voltage increase / steps up voltage (2) reduces energy loss / reduce the cost (1)	3	allow higher level answers e.g. idea of current change (1) but to reduce current (2) allow voltage reduces (1) allow reduces power loss (1) allow increases efficiency (1) ignore stops energy loss Examiner's Comments Many knew that these transformers changed the voltage and most stated that the voltage increased or was stepped-up voltage. Rather fewer went on to say that this was more efficient or wasted less energy. Examiners did not allow stops energy loss as an answer. The question specifically asked about the transformers that connected power stations to the National Grid. A significant number of candidates went on to write about the whole of the National Grid and the use of step down transformers to supply electrical energy to the home. Provided the first part was correct these were not penalised but wasted time in giving their answer. This question about nuclear power generation included one question about How Science Works and another on transformers.
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
30			idea that readings change each side of the 0 / idea that readings are positive and negative or flow in two directions (during a cycle) / AW (1)	1	ignore merely up and down / same frequency, etc. ignore merely 'all have peaks and troughs' allow all change (in) direction (1) allow all change from + to ? (1) Examiner's Comments This was quite well answered with most answers referring to positive and negative or different directions of supply. Vague answers described the signals as varying and some mistakenly explained in terms of having the same wavelength, frequency etc. Weaker answers described peaks and troughs or up and down and did not get the mark.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
31	a		any two from: idea of renewable energy (1) idea of no polluting waste produced (1) crops can be grown under them / placed at sea (1) useful in remote locations (1) (idea that) new technology are making wind turbines more efficient (than conventional power stations) (1)	2	allow does not need fossil fuels or named fossil fuel (1) allow no carbon dioxide produced / no greenhouse gases (1) allow idea of less global warming (1) allow idea of less maintenance / labour or staff required (1) allow generation close to consumer / AW (1) ignore pollution unless qualified Examiner's Comments This question on wind turbines was generally well answered although quite a few gave the disadvantages of coal powered stations rather than the advantages of wind power. The ideas of renewable energy and no greenhouse gases were the usual scoring points.
	b	i	as wind speed increases the noise increases / ora (1)	1	Examiner's Comments The majority of candidates described the main trend in the graph correctly.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	idea of: for low speeds / up to 5 m/s / up to mean speed - the noise level is below background / 33dB (1) idea of: for high speeds / above 5 m/s / above mean speed - the noise level is generally below / not much above background (1)	2	allow 'most dots below background (1) eg. 'turbine noise less than tree noise' (1) eg 'at high wind speeds the noise is rarely above background' (1) allow (if no other marks obtained) normal background is usually higher than turbine noise (1) Examiner's Comments Most gained a mark here but many candidates did not differentiate between low and high wind speeds thereby avoiding the opportunity of a second mark.
			Total	5	
32	a		0.34 or 34% (2) but if answer incorrect 170 000 (MJ) / 500 000 (MJ) ($\times 100$) (1)	2	0.34% (1) 34 (1) Examiner's Comments Candidates, in general correctly calculated the efficiency of the power station.
	b	i	direct (current) (1)	1	allow dc (1)
		ii	idea that readings change each side of the 0 / idea that readings are positive and negative or flow in two directions (during a cycle) / AW (1)	1	allow all change (in) direction (1) allow change from + to ? Examiner's Comments About half the candidates knew that a battery produces direct current (DC was also an acceptable answer). Few candidates were able to explain why all four graphs showed alternating current. Examiners were looking for an indication that the readings change from one side of the 0 line to the other or that the current kept changing direction.
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
33	a		any two from: idea of renewable energy (1) idea of no polluting waste produced (1) crops can be grown under them / placed at sea (1) useful in remote locations (1) (idea that) new technology are making wind turbines more efficient (than conventional power stations) (1)	2	allow does not need fossil fuels / named fossil fuel (1) allow no carbon dioxide produced / no greenhouse gases (1) allow idea of less global warming (1) allow idea of less maintenance / labour or staff required (1) allow generation close to consumer / AW (1) ignore pollution unless qualified Examiner's Comments The majority of candidates were able to describe the advantages of wind turbines over coal fired power stations. Whilst examiners credited advantages of wind generators it was good to see several true comparisons such as 'wind is renewable but coal will eventually run out'.
	b	i	as wind speed increases the noise increases / ora (1)	1	Examiner's Comments Very few candidates failed to score on this question and most gave the straight forward relationship 'the faster the wind the louder the noise'.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	idea of: For low speeds / up to 5 m/s / up to mean speed – the noise level is below background / 33dB (1) idea of: for high speeds / above 5 m/s / above mean speed – the noise level is generally below / not much above background (1)	2	allow 'most dots below background' (1) eg. 'turbine noise less than tree noise' (1) eg 'at high wind speeds is the noise above background' (1) allow (if no other mark awarded) normal background is usually higher than turbine noise Examiner's Comments Candidates tended to score 1 mark for the general statement that the background noise is more noisy than the turbines for most of the time. In order to score the second mark some statement about when it was above background noise was needed, for example 'even at high wind speeds the noise of the turbines is not much more than background'.
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
34	a		any value in range 0. 10 - 0.12 (1)	1	if answer line is blank allow correct answer in table Examiner's Comments Candidates were able to see the pattern in the increase in current and predict an answer in the allowed range.
	b		(larger angle) more current / AW / ORA (1)	1	ignore stronger current Examiner's Comments Around half of the entry then went on to summarise the increase of current with angle of the light beam correctly. Poorer answers were centred on the idea of more light on the photocell (with increasing angle), without relating this to the current.
	c		$5 \times 0.22 = 1.10$ (1)	1	allow first answer $\times 5$ / answer in table (for 90°) $\times 5$ Examiner's Comments Many logically explained answers using 5 times the current values for one photocell were given by candidates. Answers that only mentioned larger area so more light (falling) on 5 photocells failed to score.
	d		angle photocell to face the Sun / track position of Sun (1)	1	allow follow the Sun / always face the Sun / tilt towards the Sun / moves towards the light allow idea of photocell always facing south Examiner's Comments The idea of facing or tracking the Sun was not greatly appreciated; putting it 'in' or at 90° to the Sun were recurring answers that did not quite answer the question
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
35			Level 3 (5–6 marks) Answers must refer correctly to one explanation of the comparative power / energy losses related to currents in each circuit. Quality of written communication does not impede communication of the science at this level. Level 2 (3–4 marks) Answers refer in part to the relative power / energy losses OR changes in current in each circuit. Quality of written communication partly impedes communication of the science at this level. Level 1 (1–2 marks) Answers are limited to correct references to voltage OR show an appreciation of how the experiment models real situations. Quality of written communication impedes communication of the science at this level. Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.	6	This question is targeted at grades up to A* Indicative scientific points may include: Level 3 - less power loss in B due to reduced current and heating effect - power loss is proportional to current² Level 2 Answers show that - less power / energy is wasted at higher voltages / ORA - TA decreases current and TB increases current Level 1 - TA is step-up and TB is a step-down transformer - TA increases voltage and TB reduces voltage - Simple idea of less energy loss linked to brighter lamp in transformer circuit - resistance wires represent transmission lines in National Grid Use the L1, L2, L3 annotations in Scoris. Do not use ticks. Examiner's Comments This was a 6 mark level of response question about transformers and the National Grid targeted up to A* grade. It was deliberately challenging, although good attempts were made by most candidates, with few non-attempts. High level answers (5 or 6 marks) were for answers that explained that the transformers reduced the current, temperatures and heat loss in the wires, thus reducing energy losses. Level 2 answers (3 or 4 marks) related to the

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					voltages needing to be high to reduce energy loss. Level 1 answers (1 or 2 marks) generally described the transformers as step-up and step down. 40% of candidates failed to score and generally only grade A* candidates successfully navigated the Level 3 physics required here. The question differentiated very well.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
36		i	24 +/- 4 scores (2) But if answer is incorrect or incomplete: correct plotting of both points (1)	2	tolerance for points is +/- ½ a square Examiner's Comments The first part was about using a graph plot to estimate the current at 30cm. Most candidates gained [2] here for 24cm (20-28cm). Those failing to fall into this range of +/-4 gained [1] for the correct plotting of the points.
		ii	as distance increases current falls scores / AW / ORA (1) BUT current falls quickly at start but less quickly for greater distances / AW (2) OR as distance doubles current is quartered (2)	2	ignore stronger or weaker current allow inverse square law (2) Examiner's Comments Most candidates could describe the basic trend [1], e.g. current reduces as distance increases [1]. Some were vague in describing current as weak or strong, slow or fast [0]. Better answers (less than 10%) went on to explain that as distance doubled the output quartered [2].
		iii	light diverges / spreads / becomes less intense / AW / ORA(1) or light intensity follows an inverse square law / AW (1)	1	(when closer) more energy / photons / light hits solar cell / AW / ORA (1) Examiner's Comments Most candidates could explain the trend here.
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
37	a		Risk max 1 radiation leak / leak of nuclear material / leak of nuclear waste [1] power station / reactor may get damaged / attacked by terrorist / earthquake [1] radiation sickness / poisoning (1) how the risk is reduced / managed max 1 monitor people (for contamination) [1] monitor radiation around the nuclear power station [1] safe storage or disposal of nuclear materials [1] idea of better control of reactor [1] better shielding against radiation loss [1] have good shut down / emergency procedures [1] extra protection if in earthquake risk area [1] better security at nuclear power station [1]	2	ignore power stations emit radiation allow correct examples such as radioactive materials stored (deep) underground / encased in (thick) concrete / lead (1) allow correct examples such as surround the reactor with (thick) concrete walls (1) Examiner's Comments This HSW question focussed on the risks of nuclear power generation and how to reduce these risks. Most candidates mistakenly thought that nuclear power stations continuously emit dangerous levels of radiation. Better answers described 'leaks' or 'reactor problems' that allowed radiation to escape' [1]. Management of this risk such as creating a no-go area in such an emergency gained [1]. Nuclear waste being buried in glass deep underground was also a common answer [1].

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		Idea of voltage change [1] but voltage increase / steps up voltage [2] reduces energy loss / reduce the cost [1]	3	allow higher level answers e.g. idea of current change (1) BUT to reduce current [2] allow voltage reduces (1) allow reduces power loss allow increases efficiency (1) ignore stops energy loss Examiner's Comments About a fifth knew that (these) transformers changed the voltage [1]. Rather fewer went on to say they increased or stepped-up voltage [2] and that this was more efficient [1].
			Total	5	
38			reduces energy or power waste / heating (in cables) or increases efficiency (1) reduces costs (1) (enables) use of thinner wires (1) reduced current (due to increased voltage) (1)	2	Ignore references to 'electricity' or voltage. Eg. gets more electricity to houses (0) Eg. Less voltage lost (0) No absolutes accepted: Eg. NOT stops energy waste (completely) Eg. NOT wires don't get hot BUT wires do not get as hot scores (1) Allow more power / energy to the consumer / AW (1)
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
39	a		earth – safety wire / stops appliance becoming live / prevents shock(1) live – brown (1) neutral – blue (1)	3	
	b		live (and) neutral (1)	1	both required, either order
			Total	4	
40		i	25 000 (V) 275 000 (V) 230 (V)	1	all three correct = 1 mark
		ii	step-up used (to increase voltage) at power station or before National Grid (1) step-down used (to decrease voltage) after National Grid or at houses (1)	2	if no other marks awarded allow there are step-up and step-down transformers to change the voltage (1)
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
41			EARTH - safety wire / stops appliance becoming live / to allow (large) current or flow of charge to go to Earth / ground (if live touches metal case) (1) ----- LIVE - contains fuse or provides (high) voltage / current / energy / power (1) ----- NEUTRAL - completes the circuit (1)	3	Reference to shock must be qualified Eg. protects user from shock / can't get a shock ignore reference to fuse for this marking point not merely connects to earth / connects to the ground allow 'carries voltage' / 230 to 240V (1) ignore just 'supplies or carries electricity' allow idea of electron flow / charge flow (1) ----- allow 'is at zero volts' (1) allow carries current or charges flow (1) allow neutral wire is earthed at the power station (1)
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
42	a		AC DC DC	2	all 3 correct = 2 marks 1 or 2 correct = 1 mark
	b		maximum two from: you need a sources of energy / fuel burned (1) steam produced (1) to cause a generator to turn / turbine spins (1) maximum two from: (electricity) passes through a (step-up) transformer (1) through a network of power lines / National Grid (1) it passes through a (step-down) transformer (1) low voltage supplied to consumers (1)	3	Allow boils water
			Total	5	
43			Harry (no mark) Any one from: deforestation reduces the number of trees (1) less carbon dioxide absorbed / removed from the atmosphere / less photosynthesis AW (1)	1	allow answer without mention of Harry if deforestation reason correct
			Total	1	
44			A ✓	1 (AO1.1)	
			Total	1	

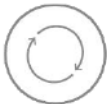
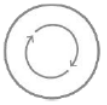
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
45	a	i	5.2 (billion tonnes oil equivalent) ✓	1 (AO3.1a)	ALLOW answers between 5.0 and 5.5 IGNORE wrong units
		ii	Oil ✓	1 (AO3.1a)	<u>Examiner's Comments</u> Part (a)(i) and (ii) assessed AO3 and required candidates to use estimated values from the graph. The majority of candidates were able to do this successfully.
		iii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 78 (%) award 2 marks 8.3 / 10.6 (x 100) ✓ =78 (%) ✓	2 (AO 2 × 3.1a)	ALLOW answers that round between 77(%) and 80(%) ✓✓ ALLOW 8.2 / 10.6 (x 100) OR 8.4 / 10.6 (x 100) OR 8.5 / 10.6 (x 100) OR answers that round between 0.77 and 0.80 <u>Examiner's Comments</u> This question required candidates to use estimated values from the graph to work out the amount of energy use due to fossil fuels and then convert their answer into a percentage of the total energy use. The question discriminated well as the lower ability candidates struggled to identify the proportion due to fossil fuel use. Many did not take into account all three of the fossil fuels which resulted in percentages that were much smaller than the expected answer. The higher ability candidates, who did identify the amount of energy use due to fossil fuels, were able to calculate the percentage correctly.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b	i	Fossil fuel may run out / is non-renewable / be in short supply / become very costly ✓ Named damage to environment: Eg (increased) greenhouse gases / global warming / sea levels rise / carbon dioxide / climate change / acid rain ✓	2 (AO3.1b) (AO3.1b)	ALLOW being used faster than being produced / finite resource ALLOW ice caps melting / droughts and storms / more polluting gases / other named polluting gases e.g. SO₂ / carbon emissions IGNORE just pollution or bad for the environment / more CFCs <u>Examiner's Comments</u> This question assessed AO3 and the majority of candidates gained at least 1 mark, usually for the idea that fossil fuels are not renewable. A significant number of candidates did not gain the second mark as their responses included statements about pollution that were too vague e.g. 'harmful emissions' or 'bad for the environment'. Exemplar 2 1. Fossil fuels are non-renewable and will eventually run out ✓ 2. Fossil fuels release lots of pollution, which causes damage to people and the planet [2] This response was credited with 1 mark for stating that fossil fuels are renewable. The second mark was not achieved as the candidate's statement that 'fossil fuels release lots of pollution' is not specific enough. To gain the second mark, the candidate should have referred to an appropriate scientific reason, for example more CO₂ or more greenhouse gases.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	To meet demand for electricity / not enough energy from renewable resources ✓ Less named damage to environment: (decreased) greenhouse gases / global warming / sea levels may fall / carbon dioxide / climate change / acid rain / ORA for coal ✓	2 (AO1.2) (AO1.2)	ALLOW will not run out as fast (as coal) / to preserve fossil fuels / produces more energy (per kg than coal) ALLOW less polluting gases / carbon emissions / ice caps melting / droughts and storms IGNORE just less pollution or just better for the environment / less CFCs <u>Examiner's Comments</u>  Although many candidates achieved 1 or 2 marks, a significant proportion did not gain any credit. Some candidates had the misconception that nuclear power is renewable. Others gave vague suggestions about 'damage to the environment'. Only the highest ability candidates usually gained full credit.   AfL Candidates should be aware that in a Physics exam what they write will be assessed as a specific scientific response. Where candidates use unnamed, vague statements about 'pollution' or 'damage to the environment' these are unlikely to gain credit. For example graffiti, fly tipping and loud music are examples of pollution that are unlikely to be caused a power station.
	c	i	Step-up transformer ✓	1 (AO1.1)	<u>Examiner's Comments</u> The majority of candidates correctly identified a step-up transformer. However, many lower ability candidates had less secure knowledge and suggested an inappropriate electrical device such as a voltmeter.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	Reduce energy wastage / loss ✓	1 (AO1.1)	ALLOW less heat loss / reduce current / reduce power loss / more useful power out / more efficient / less heating of wires DO NOT ALLOW no energy losses / prevent energy loss / AW <u>Examiner's Comments</u> This question is a direct assessment of on specification knowledge (P8.2d and P8.2e) that is in both separate Physics and Combined Science. However candidates across the ability range found it challenging and a minority of candidates correctly answered this lower demand question.  Misconception Candidates have many misconceptions about transformers and why the voltage needs be increased. They referred to many incorrect ideas such as to make the energy move faster / further, to transfer enough power to homes and to reduce the resistance. Some candidates suggested that high voltages are used in the National Grid as this reduces energy losses during transmission to zero.  OCR support There is a KS3–KS4 Transition Guide (J249) and a KS4–KS5 Transition Guide (H557) that offer support on teaching about generation of and distribution of the domestic electrical supply: http://www.ocr.org.uk/Images/324646-electricity-ks3-ks4-transition-guide.pdf http://www.ocr.org.uk/Images/309732-generating-electricity-transition-guide.pdf

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	d.c – (current / voltage / charge flow / it) has one direction or polarity ✓ a.c.- (current / voltage / charge flow / it) (continually) changes direction or polarity ✓	2 (AO1.1) (AO1.1)	ALLOW dc only positive / only negative IGNORE electricity ALLOW current / voltage alternates OR positive and negative <u>Examiner's Comments</u> Most candidates gained at least 1 mark, usually for identifying a.c. as alternating current. Common misconceptions for d.c. included 'd.c. is constant' or 'd.c. goes straight to the device'.
	d	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2.8 (kW) award 4 marks $(P =) I^2 \times R$ ✓ $11 \times 11 \times 23$ or $11^2 \times 23$ or 121×23 ✓ $= 2783$ ✓ Conversion to kW = 2.8 ✓	4 (AO1.2) (AO2.1) (AO2.1) (AO2.1)	ALLOW 2.78 kW or 2.783 kW ✓✓✓✓ ALLOW equation in any form ALLOW ECF candidates answer to 3rd marking point converted to kW <u>Examiner's Comments</u> This question required candidates to recall the equation: <i>power = current² x resistance</i> before converting their answers into kW. Out of the candidates who gained credit, most were credited with all four marks. A few candidates were only credited with one mark for converting the power output in W into kW. A significant number of candidates used an incorrect equation for power, most commonly using <i>current</i> rather than <i>current²</i>  AfL When a physics question requires candidates to apply their mathematical skills they should always write down how they are answering the question. Using brief notes is and writing down intermediate calculations helps the

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					examiner to see what the candidate is doing. A single finger error will result in many candidates receiving no credit because they only write down their final answer. Marks may be available for each stage of the process, using the correct equation, rearranging the equation, substituting in correct values. Choosing to access these compensatory marks by showing workings is good examination technique.
		ii	Wind speed varies / AW ✓	1 (AO2.1)	ALLOW it depends on the strength of the wind / how windy it is / AW IGNORE there might not be any wind / wind changes direction / AW
		iii	(Idea of) not always enough wind / demand may exceed supply / AW ✓	1 (AO2.1)	ALLOW (it) may not generate enough power / energy / AW <u>Examiner's Comments</u> Most candidates gained full credit for Q16(d)(ii) and (d)(iii). Those who did not gain credit often provided non-specific generalised reasons about the weather or the wind turbine 'breaking'.
			Total	18	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
46	a	i	5.2 (billion tonnes oil equivalent) ✓	1 (AO 3.1a)	ALLOW answers between 5.0 and 5.5 IGNORE wrong units Examiner's Comments Many candidates found it difficult to interrogate the stacked line graph and many candidates stated the total energy use in 1971 rather than the increase from 1971 to 2003. As the vertical scale on the graph was only marked at 1 billion tonne increments candidates were allowed to give an answer between 5.0 and 5.5 billion tonnes (oil equivalent).
		ii	Oil ✓	1 (AO 3.1a)	Examiner's Comments Most candidates correctly identified oil as the greatest use. Other candidates suggested coal or renewables.
		iii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 78 (%) award 2 marks 8.3 / 10.6 (× 100) ✓ =78 (%) ✓	2 (AO 2 x 3.1a)	ALLOW answers that round between 77(%) and 80(%) ✓✓ ALLOW 8.2 / 10.6 (× 100) OR 8.4 / 10.6 (× 100) OR 8.5 / 10.6 (× 100) OR answers that round between 0.77 and 0.80 Examiner's Comments Only around 10% of candidates were able to answer this question fully and most other candidates were not credited with any marks. Many candidates struggled to identify coal, oil and gas as fossil fuels. Those less able candidates that attempted to show their working were could be credited with a compensatory mark.

Mark Scheme

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	b	i	Fossil fuel may run out / is non-renewable / be in short supply / become very costly ✓ Named damage to environment: Eg (increased) greenhouse gases / global warming / sea levels rise / carbon dioxide / climate change / acid rain ✓	2 (AO 3.1b) (AO 3.1b)	ALLOW being used faster than being produced / finite resource ALLOW ice caps melting / droughts and storms / more polluting gases / other named polluting gases e.g. SO₂ / carbon emissions IGNORE just pollution or bad for the environment / more CFCs <u>Examiner's Comments</u> Most candidates recognised that fossil fuels may run out or be in short supply or stating that they are non-renewable. However, fewer candidates went on to give specific scientific reasons for scientists concerns that were creditable. Most candidates gave generalised responses about fossil fuels damaging the environment or causing 'pollution'.
		ii	To meet demand for electricity / not enough energy from renewable resources ✓ Less named damage to environment: (decreased) greenhouse gases / global warming / sea levels may fall / carbon dioxide / climate change / acid rain / ORA for coal ✓	2 (AO 1.2) (AO 1.2)	ALLOW will not run out as fast (as coal) / to preserve fossil fuels / produces more energy (per kg than coal) ALLOW less polluting gases / carbon emissions / ice caps melting / droughts and storms IGNORE just less pollution or just better for the environment / less CFCs <u>Examiner's Comments</u> Higher ability candidates said that there were not enough renewable energy resources and nuclear power stations would assist in meeting the demand for electricity, or help in preserving fossil fuels. Answers which gave detail about less damage to the environment were also credited, although a number of candidates thought that nuclear power stations would not cause any potential damage to the environment.

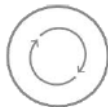
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c	i	Step-up transformer ✓	1 (AO 1.1)	Examiner's Comments One in six candidates did mention transformers. Step-up and step-down transformers are on specification knowledge (P8.2d) and candidates should know the difference that step-up transformers are used to increase the voltage distributed by power line.
		ii	Reduce energy wastage / loss ✓	1 (AO 1.1)	ALLOW less heat loss / reduce current / reduce power loss / more useful power out / more efficient / less heating of wires DO NOT ALLOW no energy losses / prevent energy loss / AW Examiner's Comments This question required candidates to apply their understanding of the National Grid from P8.2e. Only the most able candidates recalled that the higher voltage reduces energy losses but does not eliminate them. Some candidates stated that higher voltages allowed more power to be produced.
		iii	d.c – (current / voltage / charge flow / it) has one direction or polarity ✓ a.c.- (current / voltage / charge flow / it) (continually) changes direction or polarity ✓	2 (AO 1.1) (AO 1.1)	ALLOW dc only positive / only negative IGNORE electricity ALLOW current / voltage alternates OR positive and negative Examiner's Comments Only the most able candidates were able to answer this question explaining both the differences in the direction of the current flow and the polarity of the voltage. Misconception Most candidates' knowledge and understanding of a.c. and d.c. electrical supply is quite vague, and often only understood in terms of 'different directions' but not how this relates to the flow of current nor to the polarity of the voltage.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	d	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2.8 (kW) award 4 marks $(P =) I^2 \times R$ ✓ $11 \times 11 \times 23$ or 112×23 or 121×23 ✓ = 2783 ✓ Conversion to kW = 2.8 (kW) ✓	4 (AO 1.2) (AO 2.1) (AO 2.1) (AO 2.1)	ALLOW 2.78 kW or 2.783 kW ✓✓✓✓ ALLOW equation in any form ALLOW ecf candidates answer to 3rd marking point converted to kW Examiner's Comments Q23 is an overlap question with J249/04 and candidates found it very challenging with only a small number of the most able candidates being credited with any marks. From the stem of the question candidates knew that their answer needed to be between 1.0 kW and 3.0 kW. There were compensatory marks available where candidates wrote down the equation they were using and the different stages of their calculations. The most common workings shown were 11×23 or $23 \div 11$, rather than $112 \times 23 = 2.78\text{kW}$.
		ii	Wind speed varies / AW ✓	1 (AO 2.1)	ALLOW it depends on the strength of the wind / how windy it is / AW IGNORE there might not be any wind / wind changes direction / AW Examiner's Comments Many candidates realised that the wind speed would vary, but most responses were vague statements about the 'weather'.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	(Idea of) not always enough wind / demand may exceed supply / AW ✓	1 (AO 2.1)	ALLOW (it) may not generate enough power / energy / AW Examiner's Comments Two thirds of the candidates reasoned that there may not be enough wind of the required speed or that a 3.0 kW wind turbine would not be sufficient to power a household.  AfL It is very important to show candidates how to focus their answers on the question that they are being asked. For example, this question was about whether 'just one wind turbine' could be a reliable source of power a house. However, many candidates answered a question about the impact of a domestic electrical supply failure, which would apply to any source of power to a house.
			Total	18	
47			A ✓	1 (AO 1.1)	
			Total	1	
48			B ✓	1 (AO 2.1)	Examiner's Comments The majority of candidates found this question very challenging and did not recognise that the diagram showed a step-up transformer which would decrease the current in the secondary coil, and therefore decrease the power loss. Candidates also struggled to relate power loss to $I^2 \times R$. The most common incorrect answer was option C.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
49			Advantage - Any one from: no carbon dioxide produced / does not contribute to global warming/climate change/acid rain / no polluting gases ✓ small quantities of fuel needed / (idea of) more energy per unit mass ✓ fuel readily available ✓ will not run out as fast (as fossil fuels) ✓ to preserve fossil fuels ✓ Disadvantage - Any one from: Radioactive/nuclear waste produced ✓ security of transport of fuel / waste ✓ expensive to build ✓ danger of exposure to radiation ✓ decommissioning is expensive ✓ risk of accident (and after-effects)/uncontrollable (chain reaction) ✓ non-renewable ✓	2 (AO 2×1.1)	ALLOW a named polluting gas IGNORE (idea of) ozone layer ALLOW (idea of) risk from terrorists ALLOW (idea of) explosion IGNORE just dangerous <u>Examiner's Comments</u> Most candidates gained at least 1 mark, usually for identifying a disadvantage of nuclear power. Poor communication skills were an issue for many candidates and vague answers such as 'no pollution', 'produces waste', 'produces more energy' and 'expensive' did not gain any credit.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
50	a		A.C. (transmitted in power lines) / (electrical/electron/particle) oscillations / AW ✓ BUT Alternating currents/(electrical/electron/particle) oscillations produce (radio) waves/electromagnetic radiation ✓✓	2 (AO2×1.1)	<u>Examiner's Comments</u> This Assessment Objective 1 question assessed candidates' knowledge and understanding of how radio waves are produced. This proved to be one of the most difficult questions on the paper but also discriminated well. Only the most able candidates gained marks for relating the production of radio waves to the oscillations of electrons in the transmission lines.  Misconception Common misconceptions included radio waves being produced by something in the house or because the transmission lines produced heat.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		(High voltage means) lower current ✓ Less heating/heat loss/power loss/energy wasted or more useful energy transmitted / ORA ✓	2 (AO2×1.1)	IGNORE no energy losses / prevent energy loss / AW ALLOW more efficient / (wires at) lower temperature <u>Examiner's Comments</u> Although this question has been asked often in past GCSE Physics papers, over one quarter of candidates did not gain credit. Many gained 1 mark for the idea of less energy lost (as heat) but only the more able candidates were able to link this to higher voltages resulting in a lower current. AfL Candidates had many misconceptions about why energy should be transferred at high voltages. The responses often referred to incorrect ideas e.g. 'to make the energy move faster/further' or 'to transfer enough power to the home' or 'to reduce the resistance'. Candidates should also be aware that the idea of NO energy losses will not gain credit.

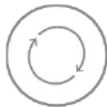
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 20 (A) award 5 marks Recall $I^2 = P / R$ ✓ 6.156 kW = 6156 W ✓ $(I^2 =) 6156 / 15.39$ OR $(I^2 =) 400$ ✓ $(I =) \sqrt{400}$ ✓ $(I =) 20$ (A) ✓	2 (AO 1.2) (AO 2.1) (AO 2.1) (AO 2.1)	ALLOW correct equation in any form DO NOT ALLOW marks to be awarded from incorrect equation e.g. $I = P / R$ Award marks if 6.156kW has not been correctly converted to W E.g. $(I^2 =) 0.4$ or $6.156/15.39$ ✓✓ $(I =) \sqrt{0.4}$ ✓✓✓ $I = 0.63$ ✓✓✓✓ <u>Examiner's Comments</u> The majority of candidates scored either zero marks or 5 marks for this question. Over a quarter of candidates did not know the correct equation: power = (current)² x resistance. It was common to see an incorrect version of the equation (power = current x resistance) used instead. Some candidates did show their calculations and could therefore score 1 mark for converting kW into W.
			Total	9	
51			C ✓	1 (AO1.1)	<u>Examiner's Comments</u> This first question was a simple recall question. Candidates are expected to know that mains electricity is a.c. (ruling out options B and D) and candidates should be able to recall that the domestic supply in the UK is a.c. at 50 Hz and about 230 V.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
52			B ✓	1 (AO1.1)	<u>Examiner's Comments</u> Candidates found this question very challenging. It tested whether candidates understood that direct current was a flow in one direction. A large number of candidates incorrectly gave response C presumably since they thought that this demonstrated a constant potential difference. The correct response shows a varying direct current.
			Total	1	
53			B ✓	1 (AO1.1)	<u>Examiner's Comments</u> Candidates generally realised that the reason was to reduce heating in wires but were confused with whether the voltage was high and the current low or the voltage was low and the current was high.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
54			A ✓	1 (AO2.1)	Examiner's Comments This question initially looks straightforward. A and D are both step-up transformers since the p.d. has increased in the secondary coil. However, in D the output power is also greater than the input power which means that the transformer would be more than 100% efficient.  AfL In these types of questions, candidates should be encouraged to work through each response perhaps indicating with a small cross any responses that can be eliminated. They should then work out each of the remaining responses. In this question, B and C could be eliminated since B is a set-down transformer and in C the p.d. remains the same. Then the power input could then be calculated for the remaining primary and secondary coils writing the values to the left and right of each row in the table.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
55			Any one from: supplies of uranium are large enough / will not run out to consider it renewable / AW ✓ Uranium is not being replaced / used quicker than it is being replaced to consider it non-renewable	1 (AO 2.1)	<u>Examiner's Comments</u> Many candidates incorrectly referred to fusion rather than fission. Candidates are advised to underline key phrases in the question paper before answering the question. Many candidates answered the question in terms of the dangerous waste products or that the waste products could be re-used. Candidates had the opportunity to explain why either of the scientists could be correct in terms of the supplies of uranium being large enough so will not run out and therefore renewable or that the uranium is not being replaced so non-renewable.
			Total	1	
56			D ✓	1 (AO2.2)	
			Total	1	
57			A ✓	1 (AO1.1)	
			Total	1	
58		i	230 (V) ✓	1 (AO1.1)	
		ii	(Earth wire together with fuse) prevents user from getting electric shock (if there is a fault) ✓ Plastic case is an insulator (so earth wire not required) ✓	2 (AO2 × 1.1)	ALLOW metal case could cause electric shock if no earth wire / AW ALLOW idea of earth wire carries current to Earth / AW ALLOW prevents projector becoming live / AW ALLOW plastic case is not a conductor / does not conduct electricity/current ALLOW appliance is double insulated
			Total	3	
59			B ✓	1 (AO2.1)	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
60		i	230 (V) ✓	1 (AO1.1)	
		ii	(Earth wire together with fuse) prevents user from getting electric shock (if there is a fault) ✓ Plastic case is an insulator (so earth wire not required) ✓	2 (AO2 × 1.1)	ALLOW metal case could cause electric shock if no earth wire / AW ALLOW idea of earth wire carries current to Earth / AW ALLOW prevents projector becoming live / AW ALLOW plastic case is not a conductor / does not conduct electricity/current ALLOW appliance is double insulated
			Total	3	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
61	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Detailed evaluation of the advantages and disadvantages of wind power AND Analysis of Fig. 18.1 and Fig. 18.2 AND An attempt to give a conclusion about the use of wind power <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Evaluation of the advantages and disadvantages of wind power AND Analysis of Fig. 18.1 and Fig. 18.2 OR Evaluation of the advantages and disadvantages of wind power AND An attempt to give a conclusion about the use of wind power OR Analysis of Fig. 18.1 and Fig. 18.2 AND An attempt to give a conclusion about the use of wind power <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Evaluation of the advantages or disadvantages of wind power OR Analysis of Fig. 18.1 or Fig. 18.2 OR An attempt to give a basic conclusion	6 (AO2 × 1.1) (AO2 × 3.1a) (AO3 × 3.2b)	AO1.1 Demonstrates knowledge and understanding of advantages and disadvantages of wind power Advantages • Wind is renewable • Does not create greenhouse gases (CO₂) • Does not contribute to global warming/climate change • Cheap to run (once built) • Less fossil fuels used Disadvantages • Unreliable – when wind drops so does power output / turbines switched off if it is too windy • Takes up lots of land • Some people think they are unsightly/noisy • Expensive to build AO3.1a Analyses information by interpreting graphs of power output and use • Wind pattern/power generated does not follow demand • Power generation is (always) below that of demand • Demand peaks at 17.00, lowest at ~5.00 • Peak demand is ~48000MW or Lowest demand is ~27000MW • Greatest power generation is ~11000MW or lowest power generation is ~5300MW • Power generation fluctuates AO3.2b Analyses information to draw conclusions about use of wind power • Current wind power cannot meet the demand for the UK • To meet the demand lots more wind turbines need to be built • Even more land/sea will be taken up with wind turbines

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			about the use of wind power <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks No response or no response worthy of credit.		• Expensive to build as so many wind turbines required • There will still be some days when wind cannot meet the demand requirements • There will need to be other power generation systems (examples given) • We need to be able to store the energy generated
			Total	6	
62			FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.9 (A) award 2 marks (Rearrangement: $I_p = I_s \times V_s / V_p$ ✓ OR $(I_p =) 12 \times 9.0 / 120$ ✓ $(I_p =) 0.9$ (A) ✓	2 (AO1.2) (AO2.1)	
			Total	2	