

Energy Resources

Name: _____

Class: _____

Date: _____

Time: **136 minutes**

Marks: **135 marks**

Comments:



Q1.

Wind and tides are energy sources that are used to generate electricity.

(a) Complete each sentence by putting a tick (✓) in the box next to the correct answer.

(i) The wind is

a non-renewable energy source.

a constant energy source.

an unreliable energy source.

(1)

(ii) The tides are

a renewable energy source.

a constant energy source.

an unreliable energy source.

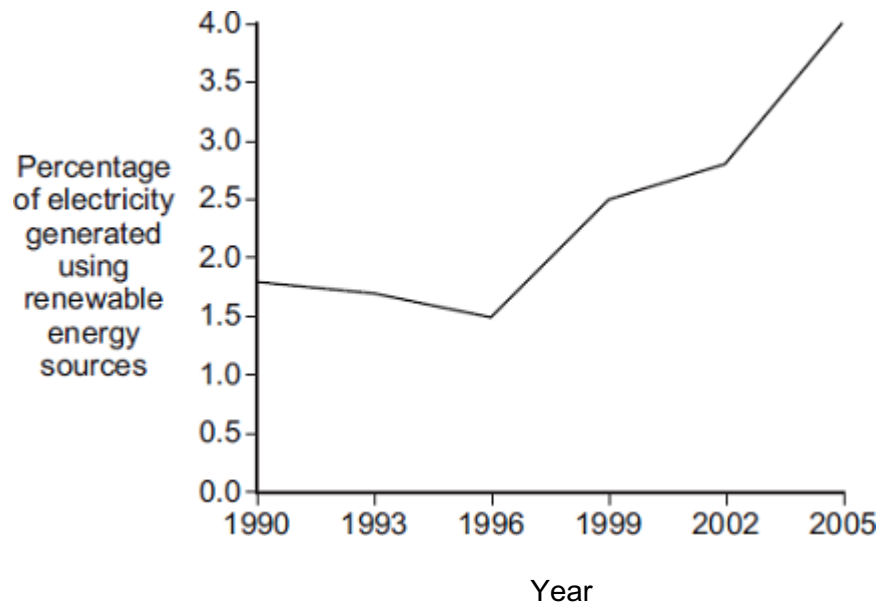
(1)

(b) If wood is to be used as a renewable energy source, what must be done each time a tree is chopped down?

(1)



- (c) In the UK, electricity is generated using renewable and non-renewable energy sources. The graph shows the percentage of electricity generated using renewable energy sources between 1990 and 2005.



Complete the following sentence by drawing a ring around the correct answer in the box.

In 2015, the percentage of electricity generated using renewable energy sources

is most likely to be

- | |
|-------------------|
| greater than 4 %. |
| equal to 4 %. |
| less than 4 %. |

(1)
(Total 4 marks)



Q2.

Three energy sources used to generate electricity are given in **List A**.
Statements about the energy sources used to generate electricity are given in **List B**.

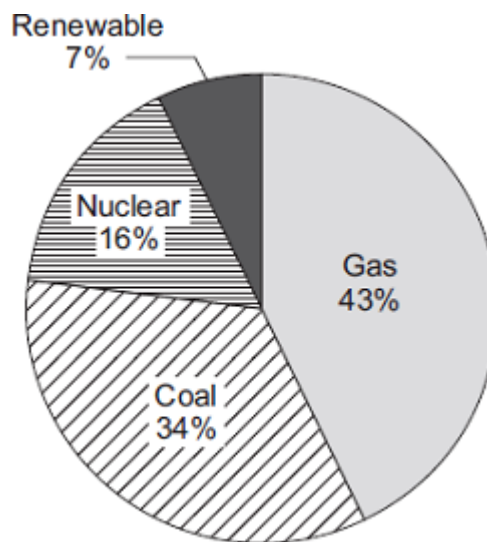
Draw **one** line from each energy source in **List A** to the statement about the energy source in **List B**.

List A Energy source	List B Statement about energy source
Geothermal	Uses energy from falling water
Hydroelectric	Uses energy from inside the Earth
Nuclear	Is unpredictable
	Produces dangerous waste

(Total 3 marks)

Q3.

(a) The pie chart shows the proportions of electricity generated in the UK from different energy sources in 2010.



(i) Calculate the percentage of electricity generated using fossil fuels.

Percentage = _____ %

(1)

(ii) The pie chart shows that 7% of electricity was generated using renewable



energy sources.

Which **one** of the following is **not** a renewable energy source?

Tick (✓) **one** box.

Oil

Solar

Wind

(1)

(b) Complete the following sentence.

In some types of power station, fossil fuels are burned to heat _____
to produce steam.

(1)

(c) Burning fossil fuels releases carbon dioxide into the atmosphere.

Why do many scientists think adding carbon dioxide to the atmosphere is harmful to the environment?

Tick (✓) **one** box.

Carbon dioxide is the main cause of acid rain.

Carbon dioxide causes global warming.

Carbon dioxide causes visual pollution.

(1)

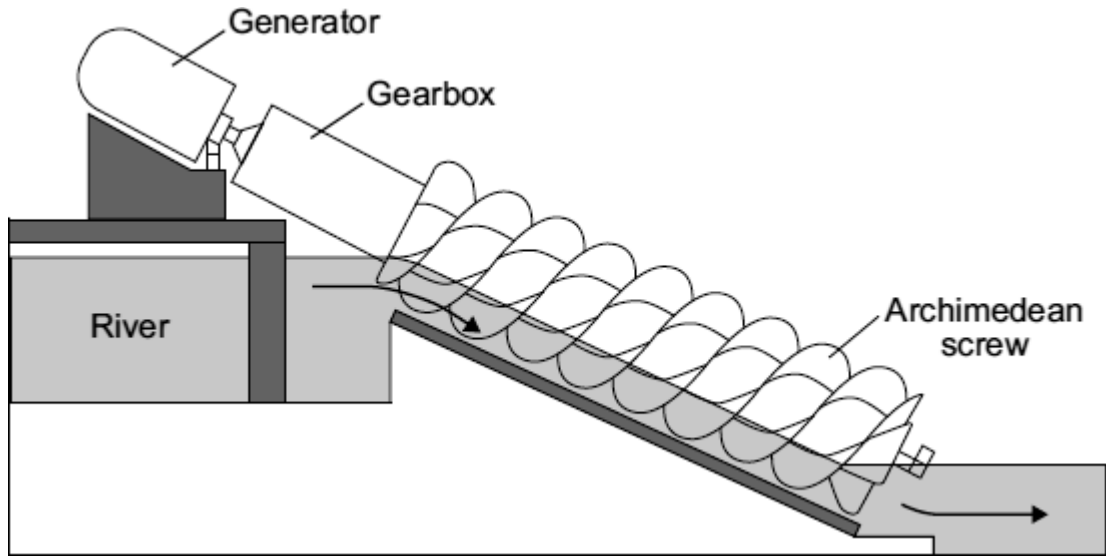
(Total 4 marks)



Q4.

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

The Archimedean screw is linked to the generator by a gearbox.



- (a) Complete the following sentence by drawing a ring around the correct word in the box.

The gravitational potential energy of the falling water is transformed

into the

chemical
electrical
kinetic

 energy of the Archimedean screw.

(1)

- (b) A micro-hydroelectric system generates about 60 kW of electricity, enough for 50 homes. A conventional large-scale hydroelectric power station may generate more than 5 000 000 kW of electricity.

- (i) Give **one** advantage of a conventional large-scale hydroelectric power station compared to a micro-hydroelectric system.

(1)



- (ii) Which **one** of the following statements gives a **disadvantage** of a conventional large-scale hydroelectric power station compared to a micro-hydroelectric system?

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

Energy is wasted as heat and sound.

Large areas of land are flooded.

A constant flow of water is needed.

(1)

- (c) The electricity generated by the micro-hydroelectric system is transferred directly to local homes. The electricity generated by a conventional large-scale hydroelectric power station is transferred to homes anywhere in the country through a system of cables and transformers.

- (i) What name is given to the system of cables and transformers used to transfer electricity to homes anywhere in the country?

(1)

- (ii) Using short cables to transfer electricity to local homes is much more efficient than using very long cables to transfer electricity to homes anywhere in the country.

Why?

(1)

- (d) Nepal is a mountainous country with over 6000 rivers. In Nepal, 9000 kW of electricity are generated using micro-hydroelectric generators.

Suggest **one** reason why in the UK much less electricity is generated using micro-hydroelectric generators, than in Nepal.

(1)

(Total 6 marks)

Q5.



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

(a) One advantage of using the wind to generate electricity is that it is a renewable energy source.

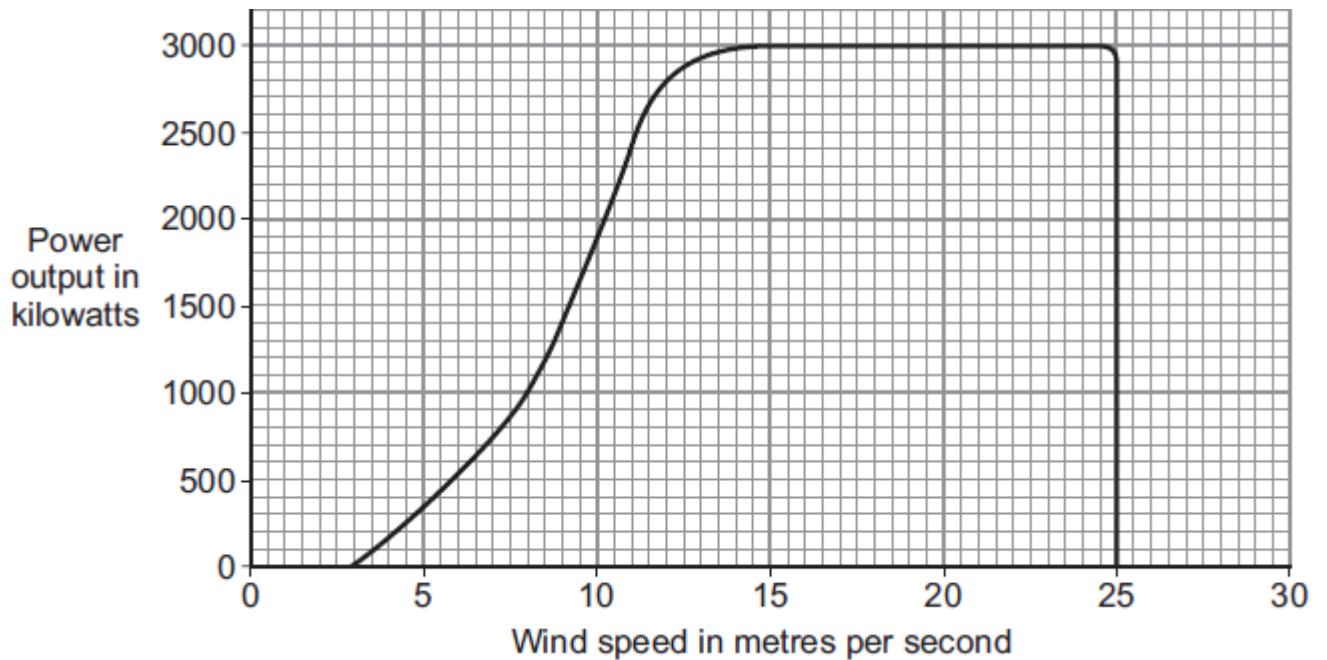
(i) Give **one** other advantage of using the wind to generate electricity.

(1)

(ii) Name **one** other renewable energy source used to generate electricity.

(1)

(b) The graph shows how wind speed affects the power output from a large wind turbine.



(i) What is the maximum possible power output from this wind turbine?

(1)



(ii) Read this part of a newspaper article.

Cold weather stops wind turbines
For the past two weeks, most of the UK's wind turbines have been generating less than one sixth of their maximum power output. To avoid major power cuts in the future, some experts have said that more nuclear power stations need to be built to provide a reliable source of energy.

Use the graph to explain why the power output from the wind turbines was less than one sixth of the maximum.

(2)

(iii) Having more nuclear power stations will help to avoid power cuts in the future.

Which **two** of these reasons explain why?

Put a tick (✓) in the boxes next to your answers.

A small amount of nuclear fuel generates a large amount of electricity.

The radioactive waste produced must be stored for many years.

Nuclear power stations do not depend on the weather to generate electricity.

(1)

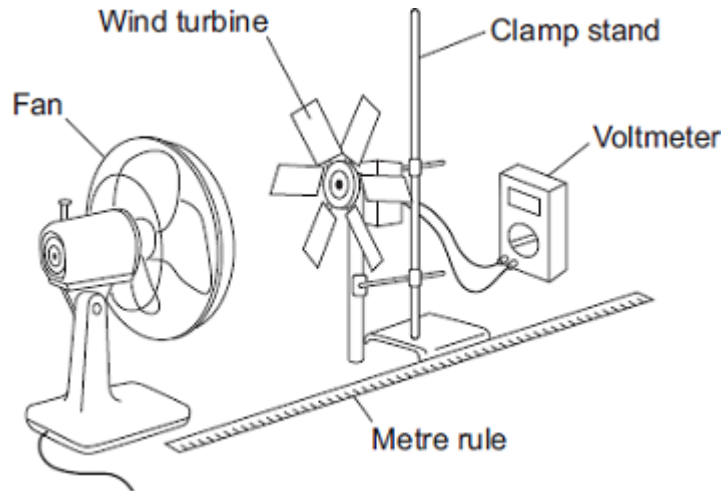
(Total 6 marks)



Q6.

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

The student used the apparatus shown in the diagram.



The fan was used to turn the wind turbine.

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

Why?

(1)

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

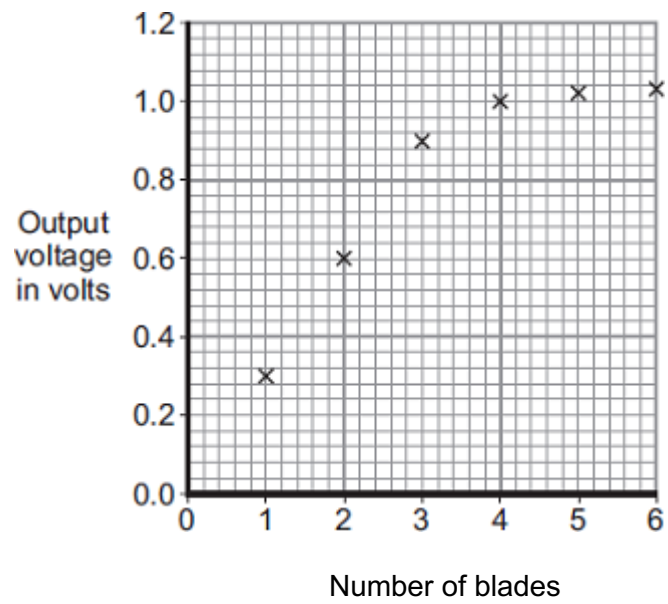
Suggest why.

(1)



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

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



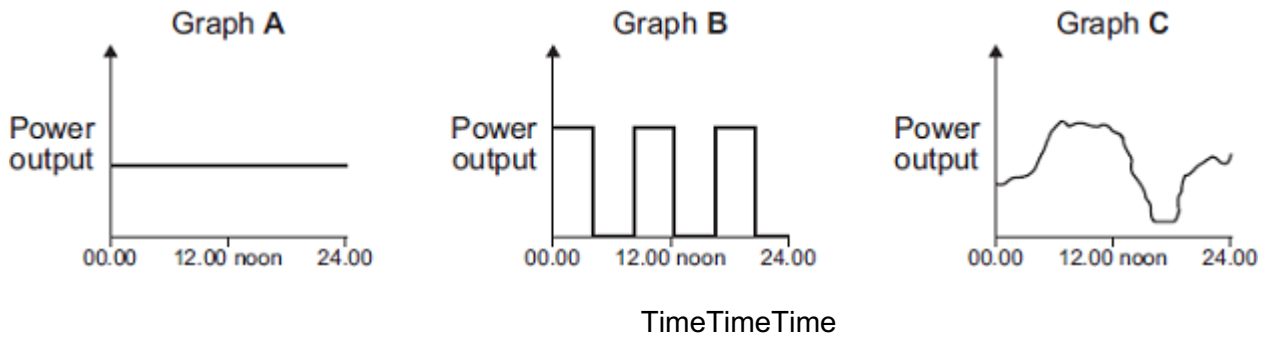
What conclusion can be made from the results in the scatter graph?

(2)



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

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



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

Give a reason for your answer.

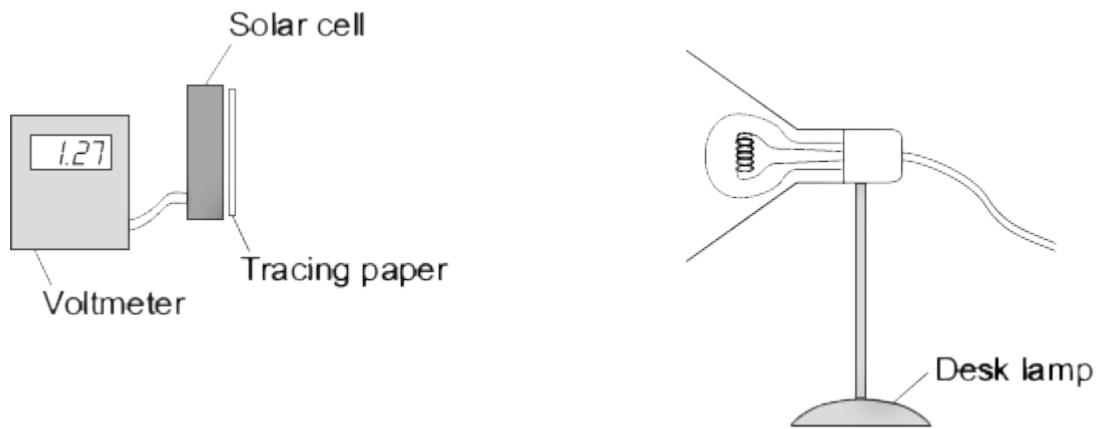
(2)
(Total 6 marks)



Q7.

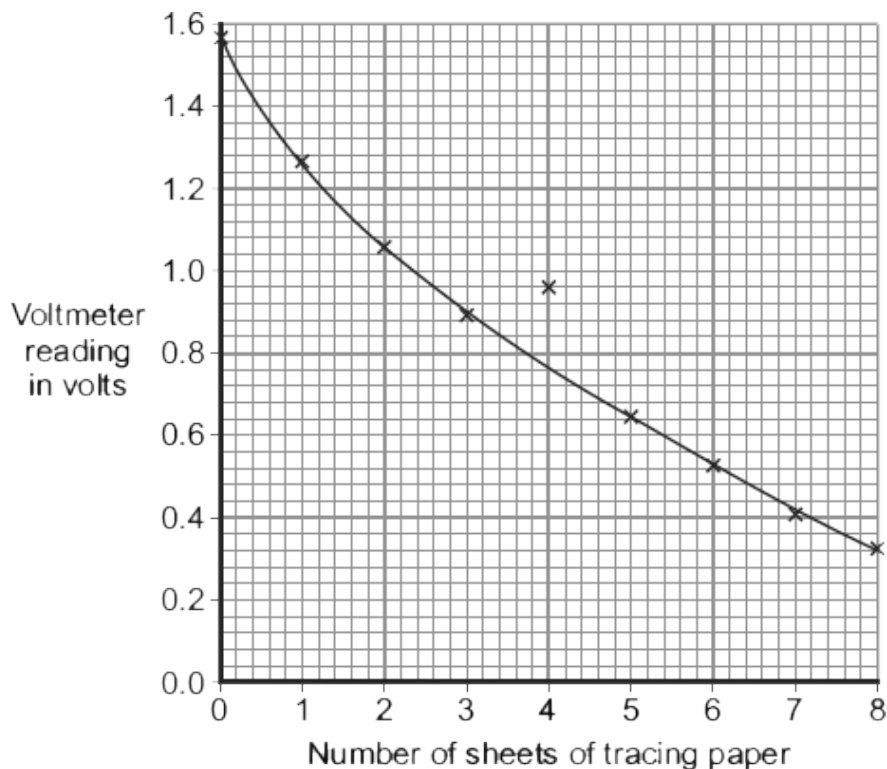
A student has read that a solar cell with a dirty surface will not work as well as a solar cell with a clean surface.

To test the effect of a dirty surface on a solar cell, the student set up the following equipment.



The student put the desk lamp a fixed distance from the solar cell. To represent the effect of a dirty surface, the student covered the surface of the solar cell with pieces of tracing paper. Each time the student added a piece of paper, she measured the output voltage of the solar cell.

(a) The results taken by the student have been used to draw the graph below.



(i) One of the results seems to be anomalous.

Draw a ring around the anomalous data point on the graph.

(1)

(ii) The larger the number of sheets of tracing paper used, the lower the intensity



of the light reaching the solar cell.

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

A decrease in the intensity of the light reaching the solar cell

causes

a decrease in
no change to
an increase in

 the output voltage from the solar cell.

(1)

(b) People can buy panels of solar cells to generate electricity for their homes. Any surplus electricity can be sold to the electricity supply company.

(i) Give **one** environmental advantage of generating electricity using solar cells rather than generating electricity in a coal-burning power station.

(1)

(ii) A homeowner pays £7600 to have solar panels fitted on the roof of their house. The homeowner expects to save £950 each year from reduced energy bills and from selling the electricity.

Assuming these figures to be correct, calculate the pay-back time for the solar panels.

Show clearly how you work out your answer.

Pay-back time = _____ years

(2)

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

Allowing the surface of the solar panels to become very dirty

will

decrease
not change
increase

 the pay-back time.

(1)

(iv) Explain your answer to part (b)(iii).



(2)
(Total 8 marks)

Q8.

Energy resources can be renewable or non-renewable.

(a) Coal is a non-renewable energy resource.

Name **two** other non-renewable energy resources.

1. _____

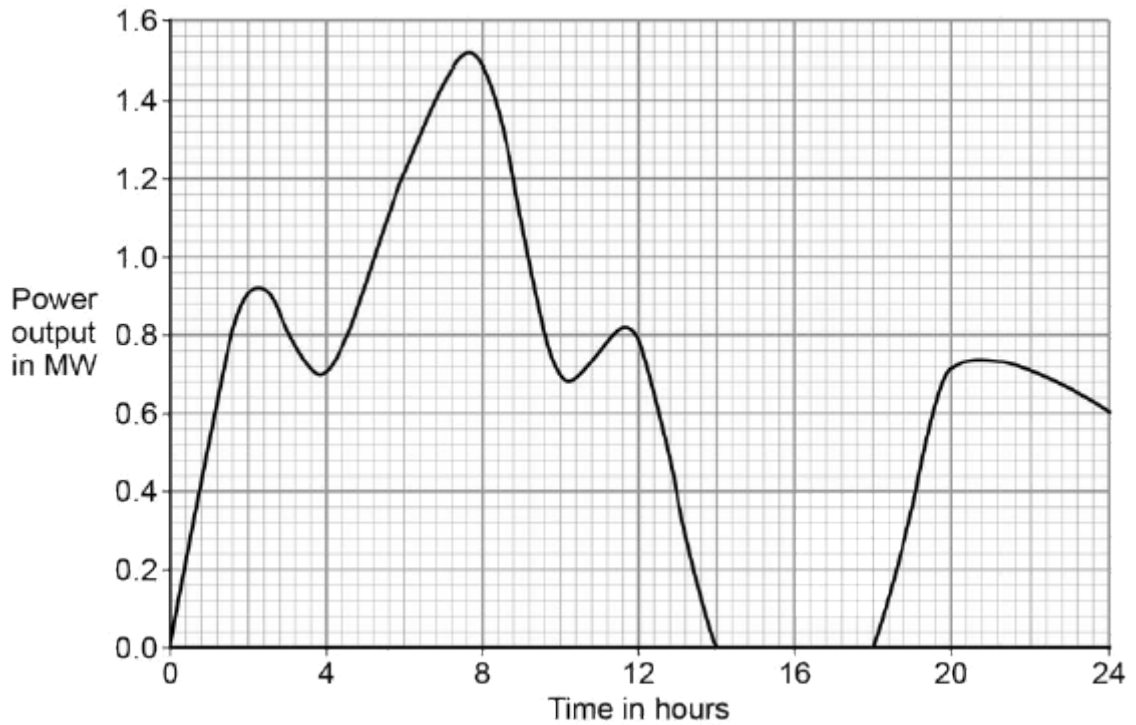
2. _____

(2)



(b) Wind turbines are used to generate electricity.

The graph below shows how the power output of a wind turbine changes over one day.



A wind turbine does not generate electricity constantly.

For how many hours did the wind turbine generate no electricity?

Time = _____ hours

(1)

(c) Electrical power is transferred from power stations to the National Grid.

What is the National Grid?

Tick **one** box.

a system of cables and pylons

a system of cables and transformers

a system of cables, transformers and power stations

(1)



- (d) An island has a large number of wind turbines and a coal-fired power station.

The island needs to use the electricity generated by the coal-fired power station at certain times.

Choose **one** reason why.

Tick **one** box.

Wind is a renewable energy resource.

Wind turbine power output is constant.

The power output of wind turbines is unpredictable.

The fuel cost for wind turbines is very high.

(1)

- (e) A wind turbine has an average power output of 0.60 MW.

A coal-fired power station has a continuous power output of 1500 MW.

Calculate how many wind turbines would be needed to generate the same power output as one coal-fired power station.

Number of wind turbines = _____

(2)

- (f) It is important that scientists develop new energy resources.

Choose **one** reason why.

Tick **one** box.

All energy resources are running out.

All energy resources are used to generate electricity.

Most energy resources have negative environmental effects.

(1)

(Total 8 marks)

Q9.



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

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

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

Cold _____ is pumped down into the ground
and is _____ by hot rocks.

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

The turbine drives a _____ to produce electricity.

(3)

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

Tick (✓) **one** box.

Geothermal power stations use fossil fuels.

Geothermal power stations produce carbon dioxide.

Geothermal power stations provide a reliable source of electricity.

(1)

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

Tick (✓) **one** box.

Falling water

A long coastline

Lots of sunny days

(1)

(Total 5 marks)



Q10.

Different energy sources are used to generate electricity.

- (a) Use words from the box to match the correct energy source to each of the descriptions given in the table.

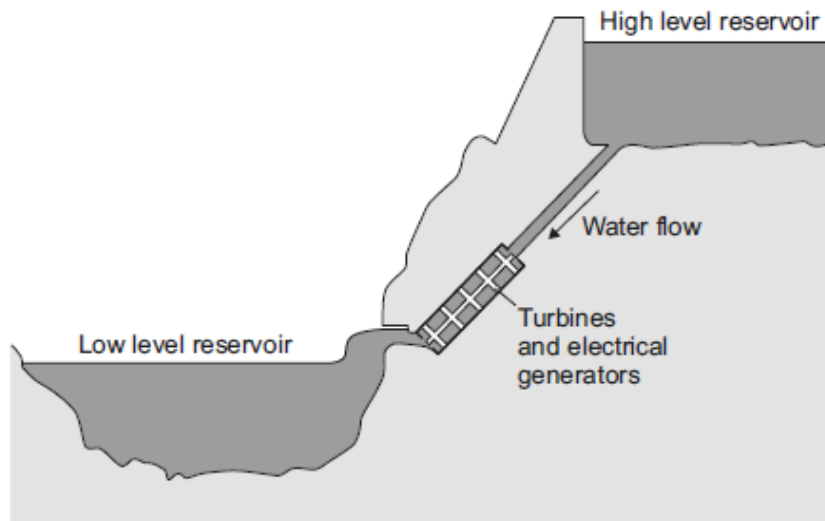
biofuel	coal	geothermal	nuclear	waves
----------------	-------------	-------------------	----------------	--------------

Description	Energy source
Energy from the Earth's core is used to heat water.	
Fission of uranium nuclei is used to heat water.	
Gases from rotting plant material are burned to heat water.	

(3)

- (b) Energy can be stored in a pumped storage power station.

The figure shows a pumped storage power station.



When electricity is needed, the water in the high level reservoir is allowed to flow to the low level reservoir. The flowing water generates electricity.

Use the correct answer from the box to complete each sentence.

electrical	gravitational potential	kinetic	nuclear	sound
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The water in the high level reservoir stores _____ energy.

The flowing water has _____ energy.

The water turns the turbine which is connected to the generator.

The generator produces some _____, this is wasted energy.

(3)

- (c) The total power input to a pumped storage power station is 600 MW.



The useful power output is 540 MW.

- (i) Calculate the efficiency of this pumped storage power station.

Efficiency = _____

(2)

- (ii) Calculate how much power is wasted by the pumped storage power station.

Power = _____ MW

(1)

- (iii) How is the temperature of the surroundings affected by the energy wasted by the pumped storage power station?

(1)

(Total 10 marks)

Q11.

Electricity can be generated using various energy sources.

- (a) Give **one** advantage and **one** disadvantage of using nuclear power stations rather than gas-fired power stations to generate electricity.

Advantage _____

Disadvantage _____

(2)

- (b) (i) A single wind turbine has a maximum power output of 2 000 000 W.

The wind turbine operated continuously at maximum power for 6 hours.

Calculate the energy output in kilowatt-hours of the wind turbine.

Energy output = _____ kWh

(2)

- (ii) Why, on average, do wind turbines operate at maximum power output for only



30% of the time?

(1)

(c) An on-shore wind farm is made up of many individual wind turbines.

They are connected to the National Grid using underground power cables.

Give **one** advantage of using underground power cables rather than overhead power cables.

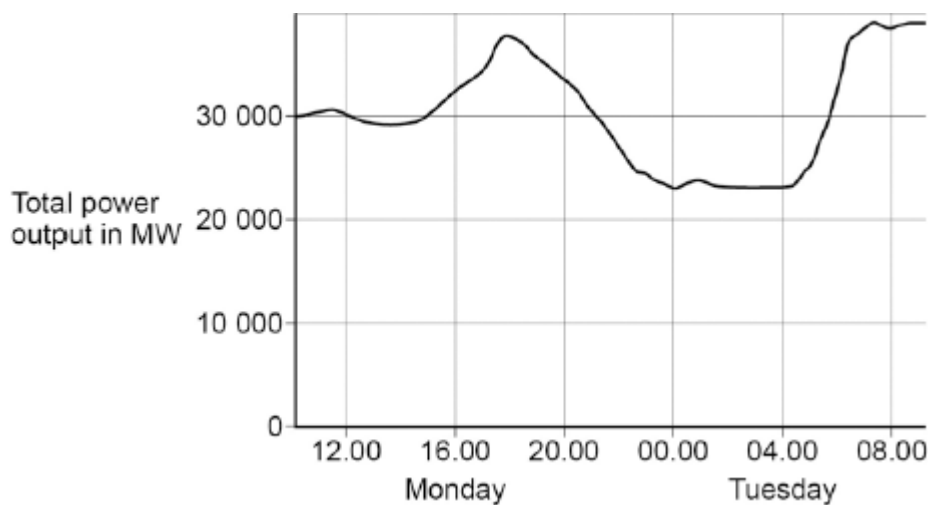
(1)

(Total 6 marks)

Q12.

The National Grid ensures that the supply of electricity always meets the demand of the consumers.

The figure below shows how the output from fossil fuel power stations in the UK varied over a 24-hour period.



(a) Suggest **one** reason for the shape of the graph between 15.00 and 18.00 on Monday.

(1)



(b) Gas fired power stations reduce their output when demand for electricity is low.

Suggest **one** time on the figure above when the demand for electricity was low.

(1)

(c) The National Grid ensures that fossil fuel power stations in the UK only produce about 33% of the total electricity they could produce when operating at a maximum output.

Suggest **two** reasons why.

1. _____

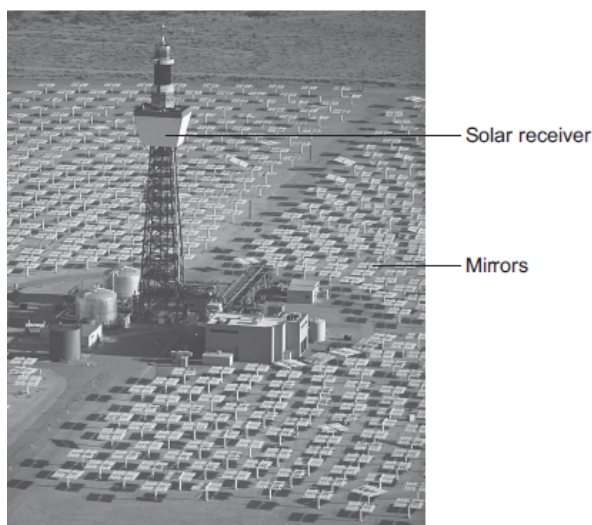
2. _____

(2)

(Total 4 marks)

Q13.

The image shows a solar thermal power station.



Energy from the Sun is directed at the solar receiver by many mirrors.

(a) (i) Suggest **one** reason why a solar thermal power station is built in a hot desert.

(1)

(ii) Complete the following sentence to describe how the mirrors direct energy



from the Sun towards the solar receiver.

Energy from the Sun is _____ by the mirrors towards the solar receiver.

(1)

- (iii) Heated water is used to generate electricity in the solar thermal power station. Choose the correct answer from the box to complete each sentence.

boiler	motor	transformer	turbine
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At the solar receiver, water is heated in a _____ which turns the water into steam. The steam turns a _____ which is connected to a water into steam. The steam turns a _____ which is connected to a generator. The generator produces electricity. A _____ is used to change the voltage for transmission along power lines.

(3)

- (b) A solar storage power station is a new type of solar power station. It is able to store energy from the Sun to generate electricity at night.

The solar storage power station can supply a town with a maximum electrical power of 140 000 kW for 15 hours.

Calculate the maximum energy, in kWh, stored by the solar storage power station.

Energy = _____ kWh

(2)



- (c) A different method of generating electricity uses wind turbines. A student researching a wind farm wrote the following.

Top Hill Wind Farm has 25 wind turbines.
Last week, one of the wind turbines generated electricity for only 42 hours out of a possible 168 hours.
My conclusion is that all wind turbines operate for only 25% of the time.

- (i) Give **two** reasons why the student is **not** correct in reaching his conclusion.

1. _____

2. _____

(2)

- (ii) Give **one** reason why wind turbines do not generate electricity all the time.

(1)

- (iii) Give **one** advantage of using wind turbines to generate electricity compared with using fossil fuel power stations.

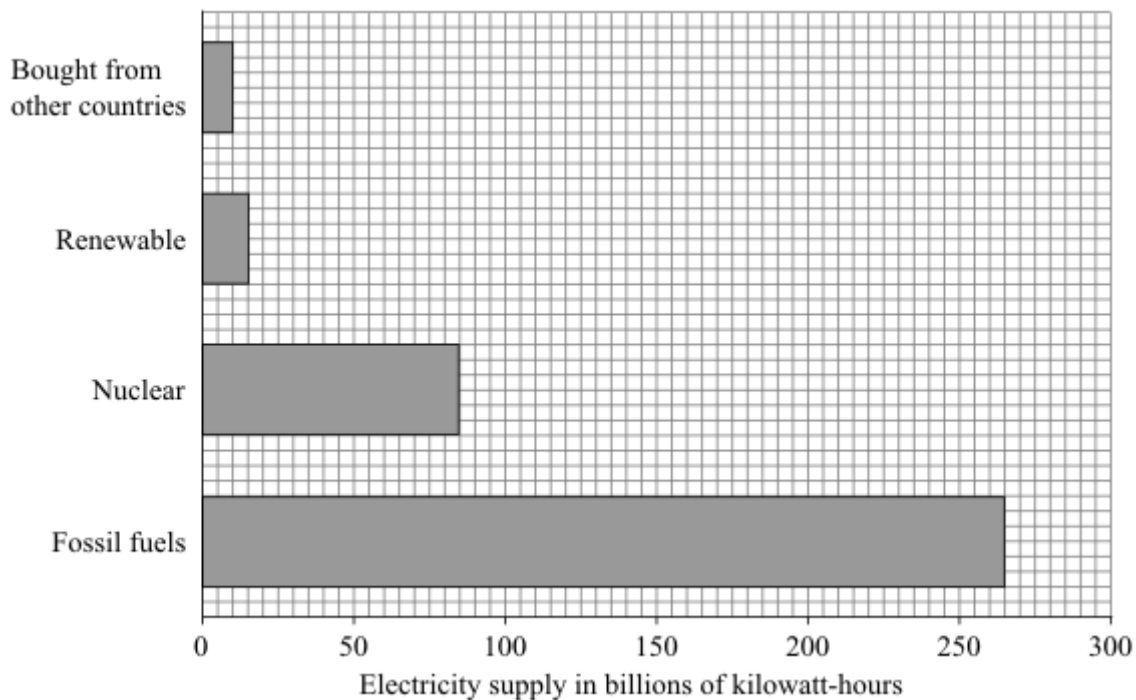
(1)

(Total 11 marks)



Q14.

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



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

Show clearly how you work out your answer.

(2)



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

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

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

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

Give a reason for your answer.

(2)

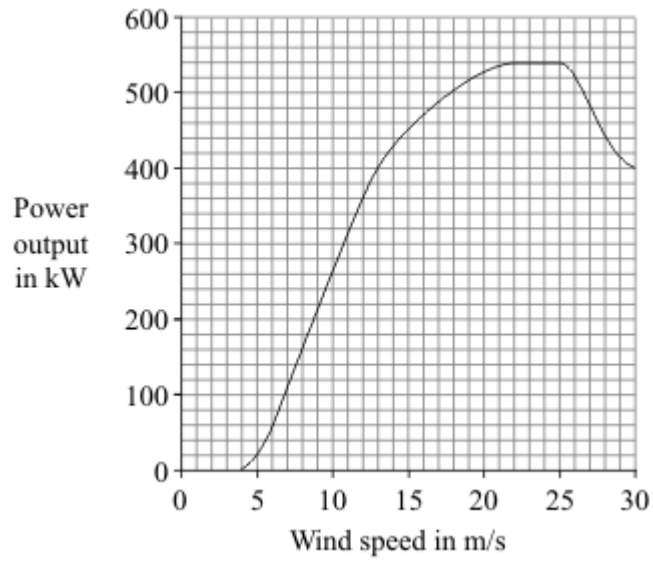
- (ii) Suggest **one** realistic way in which a householder could help to reduce the annual electricity demand.

(1)



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

The graph shows the power curve of a wind turbine.



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

(3)

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

(1)

(Total 9 marks)



Q15.

All European Union countries are expected to generate 20% of their electricity using renewable energy sources by 2020.

The estimated cost of generating electricity in the year 2020 using different energy sources is shown in **Table 1**.

Table 1

Energy source	Estimated cost (in the year 2020) in pence per kWh
Nuclear	7.8
Solar	25.3
Tidal	18.8
Wind	10.0

France generated 542 billion kWh of electricity using nuclear power stations in 2011. France used 478 billion kWh of electricity and sold the rest of the electricity to other countries in 2011.

- (a) France may continue generating large amounts of electricity using nuclear power stations instead of using renewable energy resources.

Suggest **two** reasons why.

1. _____

2. _____

(2)

- (b) Give **two** disadvantages of generating electricity using nuclear power stations.

1. _____

2. _____

(2)



(c) A panel of solar cells has an efficiency of 0.15.

The total power input to the panel of solar cells is 3.2 kW.

Calculate the useful power output of this panel of solar cells in kW.

Useful power output = _____ kW

(2)

(d) **Table 2** shows the manufacturing cost and efficiency of different types of panels of solar cells.

Table 2

Type of Solar Panel	Cost to manufacture a 1 m ² solar panel in £	Efficiency in %
A	40.00	20
B	22.50	15
C	5.00	10

Some scientists think that having a low manufacturing cost is more important than improving the efficiency of solar cells.

Use information from **Table 2** to suggest why.

(2)

(Total 8 marks)



- (b) On average, there is enough wind in the UK each year to supply all of the UK's electricity needs.

Explain why the UK may still need power stations that use fuel to generate electricity.

(2)

- (c) All European countries signed the Paris Climate Agreement in 2016.

In the future, some European countries will only allow electric vehicles.

Suggest how this is likely to affect methods of electricity generation in these countries.

(3)

(Total 9 marks)

Q17.

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

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

(2)



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

Assume the amount of fossil fuels burnt stays the same.

(1)

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

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

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

(1)

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

(1)

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

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

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

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

(1)

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

Suggest **one** reason why.

(1)

(Total 7 marks)



Q18.

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

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

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

(4)

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

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

(2)

(Total 6 marks)

Q19.

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

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

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

(1)



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

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

(1)

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

Generating electricity can increase carbon dioxide emissions.

The companies generating electricity could reduce carbon dioxide emissions.

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

1. _____

2. _____

(2)

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

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

Explain why.

(3)

(Total 7 marks)



Q20.

Nuclear power stations generate electricity through nuclear fission. Electricity can also be generated by burning shale gas.

- (a) Shale gas is natural gas trapped in rocks. Shale gas can be extracted by a process called fracking. There is some evidence that fracking causes minor earthquakes. Burning shale gas adds carbon dioxide to the atmosphere.

Describe the advantages of nuclear power compared with the use of shale gas to generate electricity.

(3)

- (b) What is the name of **one** fuel used in nuclear power stations?

(1)

- (c) Describe the process of nuclear fission.

(4)

(Total 8 marks)



Mark schemes

Q1.

(a) (i) an unreliable energy source

1

(ii) a renewable energy source

1

(b) plant / grow (at least) one new tree

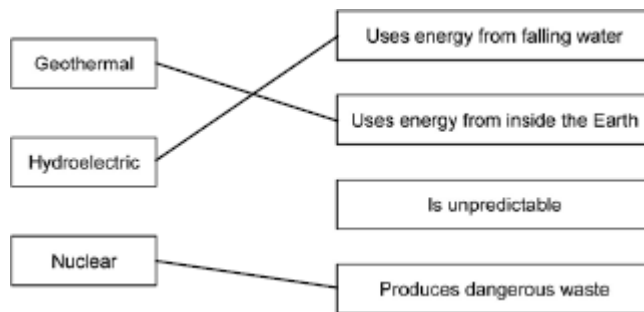
1

(c) greater than 4%

1

[4]

Q2.



allow 1 mark for each correct line

if more than one line goes from an energy source then all lines from that energy source are wrong

[3]

Q3.

(a) (i) 77

1

(ii) Oil

1

(b) water

accept H₂O

1

(c) Carbon dioxide causes global warming

1

[4]

Q4.

(a) kinetic

1

(b) (i) generates a lot more energy / electricity / power



need fewer conventional large-scale hydroelectric power stations is neutral

or

can supply (energy / electricity / power) to more homes

1

(ii) Large areas of land are flooded.

1

(c) (i) National Grid

this answer only

1

(ii) less energy / heat loss (from the cables)

accept wasted for loss

accept answers in terms of fewer transformers needed

*do **not** accept less electricity lost / wasted*

*do **not** accept no energy lost*

1

(d) any **one** from:

- fewer rivers (suitable for generators)

- less mountainous (so rivers fall smaller distances)

accept answers in terms of difficulty linking villages and towns to grid (in Nepal)

accept answers in terms of more isolated communities

accept answers in terms of UK having more resources for large-scale power stations

1

[6]

Q5.

(a) (i) any **one** from:

- produces no (air / atmospheric) pollution

accept named pollutant eg CO₂

accept no harmful gases

accept produces no emissions

accept does not add to global warming

environmentally friendly is insufficient

- energy (source) is free

accept no fuel costs

accept the wind / it is free

1

(ii) any **one** from:

- waves



- tides
- falling water
accept hydroelectric
*do **not** accept water (flow)*
- solar
accept Sun / sunlight
accept solar panels / cells
- geothermal
- biofuel / biomass
accept a named biofuel

1

- (b) (i) 3000 (kilowatts)
accept 3 megawatts / MW
accept 3 000 000 watts / W

1

- (ii) (average) wind speed below 6 m/s
answers giving a wind speed greater than 3 but less than 6 m/s gain both marks
*allow **1** mark for calculating the output as 500 kW (maximum)*
and
*allow **1** mark for wind speed too low or wind not strong enough*
*do **not** accept wind above 25 m/s*
*do **not** accept the turbines are frozen*

2

- (iii) A small amount of nuclear fuel generates a large amount of electricity.
both required

Nuclear power stations do not depend on the weather to generate electricity.

1

[6]

Q6.

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

1

- (ii) any sensible practical suggestions, eg
- so fan reaches a steady / full speed



accept power for speed

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

1

- (iii) as the number of blades increases so does the (voltmeter) reading / output / voltage

number of blades affects the reading / output is insufficient

1

further relevant detail, eg

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

1

- (b) C

reason scores only if C is chosen

1

wind speed / strength varies

*accept wind is **not** constant / reliable*

1

[6]

Q7.

- (a) (i) correct data point identified (4, 0.96)

1

- (ii) a decrease in

1

- (b) (i) no / less atmospheric pollution

accept specific examples eg no CO₂ / greenhouse gases produced

accept no harmful gases / fumes

accept reduced pollution from transportation (of coal)

accept does not contribute to global warming

it / they refers to solar cells

*do **not** accept no / less pollution*



does not harm the environment is insufficient
it is a renewable energy source is insufficient

1

(ii) 8

allow 1 mark for showing correct method ie $\frac{7600}{950}$ provided that no subsequent step is shown

2

(iii) increase

1

(iv) **these marks can score even if (b)(iii) is wrong**

less / no electricity generated
accept energy for electricity
accept reduced power / voltage output

1

(because) lower light intensity (hitting solar panel / cell)
or
so decreases money paid / gained (from selling electricity)
allow less light / sun (hitting solar panel / cell)

1

[8]

Q8.

(a) any **two** from:

- nuclear
- oil
- (natural) gas

2

(b) 4 (hours)

1

(c) a system of cables and transformers

1

(d) The power output of wind turbines is unpredictable

1

(e) 1500 / 0.6

1

2500 (wind turbines)

1

allow 2500 with no working shown for 2 marks

(f) Most energy resources have negative environmental effects.

1

[8]



Q9.

- (a) (i) water 1
- heated
accept boiled or turned to steam
*do **not** accept evaporated* 1
- generator 1
- (ii) geothermal power stations provide a reliable source of electricity 1
- (b) falling water 1

[5]

Q10.

- (a) geothermal 1
- nuclear 1
- biofuel 1
- (b) gravitational (potential) 1
- kinetic 1
- sound 1
- (c) (i) 90% or 0.9(0)
an answer of 0.9(0) with a unit gains 1 mark 2
- (ii) 60 (MW)
allow 10% 1
- (iii) increased 1

[10]

Q11.

- (a) advantage
- any **one** from:
- produce no / little greenhouse gases / carbon dioxide



- allow produces no / little polluting gases*
- allow doesn't contribute to global warming / climate change*
- allow produce no acid rain / sulphur dioxide*
- reference to atmospheric pollution is insufficient*
- produce no harmful gases is insufficient*
- high(er) energy density in fuel
 - accept one nuclear power station produces as much power as several gas power stations*
 - nuclear power stations can supply a lot of or more energy is insufficient*
- long(er) operating life
 - allow saves using reserves of fossil fuels or gas*

1

disadvantage

any **one** from:

- produce (long term) radioactive waste
 - accept waste is toxic*
 - accept nuclear for radioactive*
- accidents at nuclear power stations may have far reaching or long term consequences
- high(er) decommissioning costs
 - accept high(er) building costs*
- long(er) start up time

1

(b) (i) 12 000 (kWh)

allow 1 mark for correct substitution eg

$$2000 \times 6$$

or

$$2\,000\,000 \times 6$$

or

$$\frac{12\,000\,000}{1000}$$

an answer of 12 000 000 scores 1 mark

2

(ii) any idea of unreliability, eg

- wind is unreliable
 - reference to weather alone is insufficient*
- shut down if wind too strong / weak
- wind is variable

1

(c) any **one** from:

- cannot be seen
- no hazard to (low flying) aircraft / helicopters
- unlikely to be or not damaged / affected by (severe) weather
 - unlikely to be damaged is insufficient*



- (normally) no / reduced shock hazard
safer is insufficient
less maintenance is insufficient
installed in urban areas is insufficient

1

[6]

Q12.

- (a) power output increases (to meet demand) due to people returning home from work / school

accept many electrical appliances are switched on (which increases demand)

1

accept other sensible suggestions

- (b) 00.00

accept midnight

1

allow answers between 00.00 and 04.00

- (c) any **two** from:

- conserves fuel reserves
- spare capacity to compensate for unreliable renewable resources
- provides spare capacity in case of power station emergency shut-down
- so as to not make unnecessary environmental impact

2

[4]

Q13.

- (a) (i) high levels of infrared radiation (from the Sun)

allow lots of (solar) energy (available)

*do **not** accept 'heat' for infrared*

'it is hot' is insufficient

'lots of sunlight' is insufficient

1

- (ii) reflected

1

- (iii) boiler

correct order only

1

turbine

1

transformer

1

- (b) 2 100 000 (kWh)

*allow 1 mark for correct substitution i.e. $140\,000 \times 15$
provided no subsequent step*

2



- (c) (i) only 1 wind turbine was considered
accept only one location is considered

1

or

other wind turbines may have generated more electricity
accept insufficient sample size

only 1 week's weather was reported on

or

wind speed varies from one week to another
'wind speed varies' is insufficient

1

- (ii) any **one** from:

- wind speed is too high / low
allow no wind
allow too windy
- wind is unreliable.
allow wind is variable

1

- (iii) any **one** from:

- wind is a renewable energy source
- do not use fuel
- energy source is free
- do not release carbon dioxide
- do not release greenhouse gases
- do not release sulfur dioxide
- do not cause acid rain
- do not cause climate change
- do not cause global warming
- do not cause global dimming.

answer must be an advantage of wind, converse answers in terms of fossil fuels are insufficient

accept do not release pollutant gases

'no pollution' is insufficient

1

[11]

Q14.

- (a) 1/25 **or** 1:25 **or** 0.04

accept 4 % or $\frac{15}{375}$ or $\frac{3}{75}$ or 1 in 25 for both marks

allow 1 mark for total of 375

allow 1 mark for a clearly correct method using a clearly incorrect total

*do **not** accept 1:26*

2

- (b) (i) **B**

*do **not** credit reason if **B** is not chosen*



1

(only) burning fossil fuels produces carbon dioxide / carbon (emissions)
or nuclear fuels don't produce carbon dioxide
*insufficient – smallest amount of fossil fuels
accept less carbon dioxide*

1

- (ii) accept anything reasonable eg
increased level of insulation
use energy efficient light bulbs
do not leave appliances on standby
switch thermostats down (1°C)
generate own electricity

install solar panels
*accept insulate
accept specific examples eg loft*

1

- (c) (i) any **three** from:

- no power output until wind speed exceeds 4m/s
- output rises rapidly after 4m/s
- output begins to level out / rises less rapidly at / after 13m/s
- output peaks at 21 / 22m/s
- output constant between 21 / 22 and 25 / 26 m/s
- output falls (rapidly) after 25 / 26m/s
accept for 1 mark goes up then comes down

3

- (ii) any **one** from:

- unreliable energy source
- dilute energy source
- take up too much land
*accept wind does not always blow
accept need thousands / lots of turbines
ignore reference to visual / noise pollution
ignore reference to kill birds*

1

[9]



Q15.

(a) any **two** from:

- cost per kWh is lower (than all other energy resources)
allow it is cheaper
ignore fuel cost
ignore energy released per kg of nuclear fuel
- infrastructure for nuclear power already exists
accept cost of setting up renewable energy resources is high
accept many renewable power stations would be needed to replace one nuclear power station
accept (France in 2011 already had a) surplus of nuclear energy, so less need to develop more renewable capacity for increased demand in the future
accept France benefits economically from selling electricity
- more reliable (than renewable energy resources)
accept (nuclear) fuel is readily available
ignore destruction of habitats for renewables

2

(b) any **two** from:

- non-renewable
allow nuclear fuel is running out
- high decommissioning costs
accept high commissioning costs
- produces radioactive / nuclear waste
allow waste has a long half-life
- long start-up time
- nuclear accidents have widespread implications
allow for nuclear accident a named nuclear accident
eg Fukushima, Chernobyl
ignore visual pollution

2

(c) 0.48 (kW)

allow 1 mark for correct substitution
ie $0.15 = P / 3.2$
an answer of 480 W gains 2 marks
an answer of 48 or 480 scores 1 mark

2

(d) the higher the efficiency, the higher the cost (per m² to manufacture)
accept a specific numerical example

1

more electricity could be generated for the same (manufacturing) cost using lower



efficiency solar panels
or
(reducing the cost) allows more solar panels to be bought
accept a specific numerical example

1

[8]

Q16.

(a)

Level 2: Relevant reasons are identified, given in detail and logically linked to form a clear account.	3-4
Level 1: Relevant reasons are identified, and there are attempts at logically linking. The resulting account is not fully clear.	1-2
No relevant content	0
Indicative content nuclear <ul style="list-style-type: none"> • no carbon dioxide released (when generating electricity) or doesn't release greenhouse gases • reliable • high energy density • power stations already built • other power stations being built wind <ul style="list-style-type: none"> • no carbon dioxide released (when generating electricity) or doesn't release greenhouse gases • renewable energy resource • no fuel cost 	

4

(b) wind power is unreliable

1

(so) will be unable to meet demand when wind speed is low
or
when there is no wind
or
unable to maintain base load at all times

1

(c) electricity generation will need to increase (to meet higher demand)

1

(using)
nuclear power
or



wind power
or
other renewables

1

so that carbon dioxide emissions don't increase
or
reference to Paris Climate agreement

1

[9]

Q17.

- (a) (i) produces carbon dioxide / nitrogen oxides
accept greenhouse gases
ignore pollutant gases

1

that (may) contribute to global warming
accept causes global warming
damages ozone layer negates this mark
accept alternative answers in terms of: sulfur dioxide /
nitrogen oxides causing acid rain

1

- (ii) carbon capture / storage
answer must relate to part (a)(i)
collecting carbon dioxide is insufficient

or

plant more trees

or

remove sulfur (before burning fuel)

1

- (b) (i) (power station can be used) to meet surges in demand
accept starts generating in a short time
can be switched on quickly is insufficient

1

- (ii) can store energy for later use
accept renewable (energy resource)
accept does not produce CO₂ / SO₂ / pollutant gases

1

- (c) (i) turbines do not generate at a constant rate
accept wind (speed) fluctuates
accept wind is (an) unreliable (energy source)

1

- (ii) any **one** from:

- energy efficient lighting (developed / used)



use less lighting is insufficient

- increased energy cost (so people more likely to turn off)
accept electricity for energy
- more people becoming environmentally aware

1

[7]

Q18.

- (a) *answers must be in terms of nuclear fuels*

concentrated source of energy

idea of a small mass of fuel able to generate a lot of electricity

1

that is able to generate continuously

accept it is reliable

or *can control / increase / decrease electricity generation*

idea of available all of the time / not dependent on the weather

ignore reference to pollutant gases

1

the energy from (nuclear) fission

1

is used to heat water to steam to turn turbine linked to a generator

1

- (b) carbon dioxide is not released (into the atmosphere)

1

but is (caught and) stored (in huge natural containers)

1

[6]

Q19.

- (a) any **one** from:

- energy / source is constant
- energy / source does not rely on uncontrollable factors
accept a specific example, eg the weather
- can generate all of the time
will not run out is insufficient

1

- (b) (dismantle and) remove radioactive waste / materials / fuel

accept nuclear for radioactive

knock down / shut down is insufficient

1



- (c) any **two** from:
- reduce use of fossil fuelled power stations
accept specific fossil fuel
accept use less fossil fuel
 - use more nuclear power
accept build new nuclear power stations
 - use (more) renewable energy sources
accept a named renewable energy source
*do **not** accept natural for renewable*
 - make power stations more efficient
 - (use) carbon capture (technology)
*do **not** accept use less non-renewable (energy) sources*

2

- (d) (by increasing the voltage) the current is reduced

1

this reduces the energy / power loss (from the cable)
accept reduces amount of waste energy
accept heat for energy
*do **not** accept stops energy loss*

1

and this increases the efficiency (of transmission)

1

[7]

Q20.

- (a) any **three** from:
- no carbon dioxide emitted (to produce electricity)
no greenhouse gases is insufficient
 - doesn't cause global warming
allow climate change or greenhouse effect for global warming
 - nuclear power doesn't cause earthquakes
 - more energy released per kg of fuel (compared to shale gas)

3

- (b) uranium
or
plutonium
ignore any numbers given

1

- (c) a neutron is absorbed by a (large) nucleus
a description in terms of only atoms negates first two marking points

1



the nucleus splits into two (smaller) nuclei

1

releasing energy (and gamma rays)

1

and (two / three) neutrons

1

[8]



Examiner reports

Q1.

- (a) (i) Just over half the students realised that wind was an unreliable source, with about a third suggesting that it was 'constant'.
- (ii) Less than half the students chose the correct response in this question.
- (b) Most students realised that planting one or more new trees meant that wood could be used as a renewable energy source.
- (c) Most students were able to gain the mark in this question.

Q2.

This question was well answered, with approximately two thirds of the students scoring all three marks. The most common wrong response was to say that a nuclear energy source is unpredictable.

Q3.

- (a) (i) Only about one third of the students were able to answer this question correctly, although most attempted a calculation. The problem would appear to be that most students did not realise which of the energy sources were fossil fuels. The most common answer was 93%, i.e. adding up all of the energy sources apart from renewable.
- (ii) Most students were able to identify oil as being the energy source that is not renewable.
- (b) About half of the students knew that fossil fuels are burned to heat water.
- (c) Although most of the students knew that carbon dioxide causes global warming, some thought that carbon dioxide is the main cause of acid rain.

Q4.

- (a) Most candidates correctly chose kinetic energy, the most common wrong answer being electrical.
- (b) (i) This question was well answered by the majority of candidates with just over three quarters of candidates scoring the mark.
- (ii) Surprisingly only the better candidates correctly chose 'large areas of land are flooded'. The most common answer was 'A constant flow of water is needed'.
- (c) (i) Just over a third of candidates stated that this was the National Grid.
- (ii) Only the better candidates were able to relate the use of short cables to the idea of energy losses. Common incorrect answers often referred to electricity being lost or to electricity travelling faster in shorter cables.
- (d) This question was answered well by the majority of candidates.



Q5.

- (a) (i) Surprisingly many students did not score this mark. Many students concentrated on explaining that wind was a renewable energy source, forgetting that this was given in the stem of the question. Others simply suggested that wind was 'natural' or 'good for the planet'. Students found it difficult to differentiate between the cost of the wind as an energy source (free) and the cost of electricity from wind turbines, many imagining that it was free or very cheap.
- (ii) Many students were able to give one example of a renewable energy source, solar being the most popular. 'Water' was not accepted as an energy source unless it was apparent that the answer referred to 'falling water'.
- (b) (i) Most students gained this mark.
- (ii) Many students tried to explain the shape of the graph and ignored the question that they were asked. The students appeared to assume that the horizontal axis represented time and suggested that the 'wind started low, gathered speed and then got so fast that the output dropped to zero – all in 25 seconds'. Others stated that there was either no wind or its speed was too high and so 'no power' would be generated. However, the question referred to power generation at a lower rate and so these answers were incorrect. Few students were prepared to give a wind speed appropriate to the scenario that the question outlined, but a minority were able to gain one mark for saying that the wind was too low during this time period. There were frequent references to the turbines freezing or icing up.
- (iii) The majority of students gained this mark.

Q6.

- (a) (i) By far the most common answer to this question was "to make it a fair test". This is not sufficient. Only about 20% of students realised that if the distance was altered this would affect the speed of the wind reaching the turbine blades.
- (ii) Slightly fewer than half of the students realised that it would be necessary for the reading on the voltmeter to stabilise before taking a measurement. A significant proportion of students thought that the fan must be switched off and it was necessary for the turbine blades to stop spinning before taking a reading.
- (iii) The majority of students could state that as the number of blades increased, so did the output voltage. However, only the better students went on to explain that there was a limit to the output voltage. Some students thought that the turbine was responsible for producing the wind.
- (b) About half of the students correctly identified graph **C** as being the one that represented the output from the wind turbine. However, only the better students could provide an acceptable reason for this choice. Some students thought the graphs showed how demand for electricity varied throughout the day.

Q7.

- (a) (i) The vast majority of students were able to correctly identify the anomalous point, although a significant number made no attempt at this question.



- (ii) Most students realised that a decrease in light intensity would lead to a decrease in output voltage.
- (b) (i) Most students correctly identified the fact that there would be less atmospheric pollution, or less carbon dioxide being emitted. Those who failed to score the mark were either giving very vague general answers such as 'it is environmentally friendly' or 'doesn't cause pollution' or were simply stating that it is a renewable resource.
- (ii) The great majority of students obtained the correct answer to this calculation. The most frequent mistake was to deduct 950 from 7600, thereby arriving at an answer of 6650 years for the pay-back time.
- (iii) Over half of the students thought that allowing the surface of the solar cells to become dirty would decrease the pay-back time. It would appear that there is a common misunderstanding about what is meant by pay-back time.
- (iv) Most students were able to score one mark for this question, but only the better students scored both marks. This applied even to those students who thought that the pay-back time would be decreased.

Q9.

- (a) (i) Only about a quarter of students correctly described how geothermal power stations work. Cold water being pumped down into the ground was the most frequent correct response out of the three. A common error was to state that a motor produces electricity.
- (ii) About three-quarters of the students correctly indicated that geothermal power stations provide a reliable source of electricity.
- (b) About three quarters of the students correctly indicated that hydroelectric power stations need running water to operate.

Q10.

- (a) Just over half the students scored all 3 marks, the most common mistake was to mix up geothermal and nuclear.
- (b) Just over a third of students scored 3 marks on this question, with just under a third scoring 1 mark. The remaining third either scored 2 or 0 marks. Students found this question quite difficult, many believing that the water stored electrical energy.
- (c) (i) Just under a third of students scored both marks for this question, a third of students scored 1 mark for this question. The most common mistake was to either omit the % symbol or add an incorrect one, MW, for example.
- (ii) Almost two thirds of students scored this mark. Common incorrect responses included multiplying or dividing the power input and output for the power station. An answer of 10% was creditworthy, provided the % sign was given.
- (iii) Two fifths of students scored this mark. Common incorrect responses seen included global warming and pollution. The 'turbine overheating' was insufficient for the mark.

Q11.



- (a) A low proportion of students could give an advantage and a disadvantage of a nuclear power station compared with a gas-fired power station. A further quarter could give either an advantage or a disadvantage. Too many answers were vague and referred simply to pollution, rather than naming a gas. A common misunderstanding was to say that nuclear power stations give out carbon dioxide gas. A common misreading of the question was to give an advantage for a nuclear power station and a disadvantage for a gas-fired power station.
- (b)
 - (i) Nearly two thirds of the students were able to substitute a power and time value into the correct equation. A low proportion of students were able to convert the given power into kilowatts.
 - (ii) Just over a half of students were able to state that the wind is a variable and unreliable source of energy. The figure of 30% proved a distractor for weaker students who often quoted that 70% of the energy was wasted. Those students who mentioned that the output was weather-dependent were not given credit. The key aspect is variation in wind speed or power. Some students appear to believe that wind turbines are operated by supplying them with electrical energy, and are shut down to conserve energy.
- (c) Two fifths of the students were able to give an advantage of underground cables compared with overhead cables. Too many statements were vague, students were expected to give some detail of why underground cables are less likely to be damaged. There are still a large number of students who believe that birds will be electrocuted if they land on overhead power cables.

Q13.

- (a)
 - (i) Most students referred to large amounts of sunlight or heat but very few linked this to there being a plentiful supply of energy for the power station. Reference to infrared radiation was rarely seen.

Many of the weaker students confused the installation with solar panels, and consequently were answering in terms of light.

Comments about the weather were common, e.g. 'it is always sunny' but were insufficient.
 - (ii) The majority of students correctly stated that the energy from the Sun is reflected by the mirrors. Incorrect responses included the words 'absorbed' or 'transferred'.
 - (iii) This question was well answered with most students scoring all 3 marks. The most common mistake was students thinking that the steam turned a motor rather than a turbine.
- (b) This question was well answered, with the majority of students scoring 2 marks. Incorrect answers were usually due to dividing instead of multiplying, incorrect substitution (usually a factor of 10) or, occasionally, selecting the wrong formula. Marks were lost by dividing a correct calculated answer by 1000. Many couldn't place commas in the correct place in the number. The most common error occurred when students divided by 1000, in spite of the fact that the question stated that the answer was required in kWh.
- (c)
 - (i) Very few students scored both marks. Many students scored one mark by stating that only one turbine had been tested. Very few gained a mark for realising that the survey had only been carried out over a period of one week.



Very common answers which were not creditworthy were 'it was not windy enough' and 'the wind varies (from day to day)'.

Many students thought that the calculations were incorrect, with statements such as '42 days is not 25% of a week' and '168 hours is not one week'.

- (ii) This question was well answered, with most students gaining the mark. Vague responses not gaining credit gave references to 'the weather' or 'electricity not needed all the time'. There were a number of answers which were not related to wind being the source of energy of the turbine.
- (iii) The most common acceptable responses were in terms of being a renewable source or that no carbon dioxide was emitted. References to global warming and greenhouse gases were also seen and were creditworthy.

The most common answers failing to gain credit were usually general and vague terms such as 'no pollution' or 'they are environmentally friendly'.

Answers that gave disadvantages of non-renewable sources were insufficient. Just less than half of the students scored the mark.

Q14.

- (a) Some candidates had problems reading all 4 values from the graph correctly, but did gain one mark for showing correct working. A significant number of candidates, having read the values correctly, were unable to calculate a proportion.
- (b)
 - (i) This was generally well answered. The most common one-mark answers chose student B but failed to explain the link between fossil fuels and carbon dioxide emissions.
 - (ii) This was very well answered with candidates showing a practical understanding of the problem. The most common response being 'don't leave appliances on standby'.
- (c)
 - (i) Whilst many candidates were able to score one or two marks for picking out a couple of significant features of the graph, detailed answers were not common. A number of candidates failed to gain any credit for answers which tried to describe the action of a wind turbine. Some candidates seemed to think that because the line went down after 25 m/s, this was showing that the wind speed was falling. A cause for concern was the idea that it is the wind turbines that create the wind!
 - (ii) This was well answered by many candidates, the most common error being a general description of wind turbines such as noisy and an eye-sore.

Q15.

- (a) This question was well answered with half the students scoring 1 mark and a third of students scoring 2 marks. The most common correct answers referred to the cost per kWh and the economic benefits, 'France can sell their excess electricity to other countries' type of statement. Insufficient responses included 'it's cheap', which wasn't comparative; or references to no CO₂ released, as the renewables mentioned don't release CO₂ either. Reliability was another commonly seen response, which was creditworthy.
- (b) Just under a third of students scored 2 marks for this question. Answers that were



insufficient were 'dangerous', or 'radiation may leak'. Naming nuclear accidents was insufficient for a mark, the idea of widespread or major implications was necessary too. Commissioning or decommissioning time was insufficient as the question was about generating electricity, so while the cost was an issue, time was too vague. A number of students thought that 'nuclear is a fossil fuel so contributes greatly to global warming', which is clearly incorrect.

- (c) Three fifths of students scored 2 marks for this question. Some students incorrectly multiplied their answer by 100(%) and got an answer of 48, which scored 1 mark, or multiplied the power in W by 0.15 and got an answer of 480, which also scored 1 mark.
- (d) Three fifths of students scored 1 mark for the idea that higher cost meant higher efficiency solar panel, quite a lot of students also scored 1 mark for the idea that if cheaper, more would be bought. Many students, however, incorrectly thought that if you purchased a larger number of solar panel C, the overall efficiency would increase. These students are likely to have scored a maximum of 1 mark for the idea that more could be bought, depending how they worded their answer. Only a tenth of students scored 2 marks for a well-reasoned answer e.g. The more efficient solar panels cost more, but you could buy more solar panel C for £40, that would generate more electricity than 1 solar panel A.

Q17.

- (a)
 - (i) This was generally well answered with over half of the students scoring both marks. The most common answers were related to carbon dioxide and global warming.
 - (ii) There were some good answers describing carbon capture methods. However, a significant number of students failed to take notice of the statement that 'the amount of fossil fuels burnt stays the same' and gave answers relating to reducing the amount of fossil fuels burnt.
- (b)
 - (i) This was well answered by over half of the students. A common error was to state what a 'short start-up time' was, rather than explaining its importance.
 - (ii) Over half of the students scored the mark here, the most common answer being 'renewable', with a minority realising the significance of it being a way to store energy for use at a later time.
- (c)
 - (i) This was well answered by nearly two-thirds of students. It appeared that a significant number of students did not understand the word 'fluctuations'.
 - (ii) Again this was well answered, the most common response referring to the increased use of energy saving light bulbs.

Q18.

- (a) The term 'nuclear fission' was well known. However, it is alarming how many students think that nuclear fuels are burned in order to release energy. The process of generating electricity was not well described; many students seem to think that it is the turbine that generates the electricity. An advantage of nuclear fuels 'reliability' was often given. However, many students spent a lot of time and filled a lot of space describing numerous disadvantages of nuclear energy and / or the advantages and disadvantages of wind with no reference at all to nuclear energy.
- (b) Nearly a fifth of students did not attempt this question. Many students simply



repeated the stem of the question and had no idea about the storage of the carbon dioxide following its 'capture'. A common error was the assumption that 'carbon capture' involves the removal of the existing carbon dioxide from the atmosphere.

Q19.

- (a) This question was quite well answered by around half of the students.
- (b) The majority of students seemed unfamiliar with the term 'decommissioning'.
- (c) Around three-quarters of students scored at least one mark. There was evidence that some students had not taken on board that the question referred to 'companies generating electricity', as their answers referred to 'energy saving appliances' or 'switching lights off'.
- (d) Under half of the students were able to score at least one mark, with only a small number of responses scoring all three marks. Common errors were to talk about 'electricity' being lost in the cables, or 'no energy will be lost'.

Q20.

- (a) 11% of students scored 3 marks, 27% of students scored 2 marks. Lots of thorough answers were seen, but they needed to state the advantages of nuclear, rather than disadvantages of shale gas. 'Shale gas releases CO₂' did not score a mark, but 'nuclear does not release CO₂' did score a mark. Information about shale gas was given in the question, which is why these answers were insufficient for a mark.
- (b) 66% answered this question correctly. The most common correct answer was uranium. A common incorrect answer seen was oil.
- (c) Many good answers seen with 12% scoring 4 marks and 20% scoring 3 marks. Some students didn't mention the nucleus absorbing the neutron or the nucleus splitting in two, so they didn't score the first two marking points. The first marking point was the least likely to score. The third marking point was scored by most students.

