Energy Questions Part 1

35 Questions

Name: _____

Class: _____

Date: _____

Time: **Unlimited**

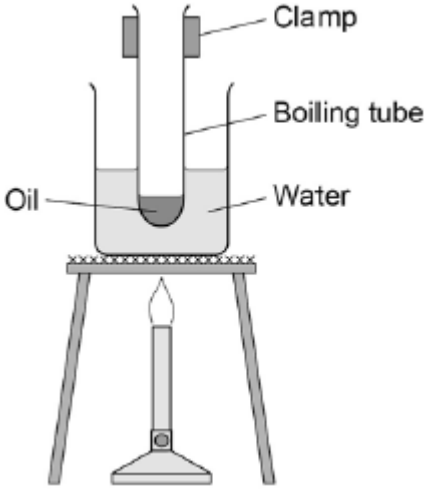
Marks:

Comments:

Q1.

A student investigated the change in temperature when oils of different specific heat capacities were heated.

She set up the apparatus shown in the figure below.



This is the method used.

1. Put 25 g of oil into a boiling tube.
2. Pour 100 ml of water into a beaker and heat it with a Bunsen burner.
3. When the water is boiling, put the boiling tube into the beaker.
4. When the temperature of the oil reaches 30 °C, heat for a further 30 seconds and record the rise in temperature.
5. Repeat with different oils.
6. Repeat the whole investigation.

(a) Name **two** pieces of apparatus the student used that are **not** shown in the figure above.

1. _____

2. _____

(2)

(b) What are the independent and dependent variables in the student's investigation?

Independent _____

_____

Dependent _____

_____

(2)

(c) Give **two** safety precautions the student should have taken.

1. _____

_____

2. _____

_____

(2)

(d) Suggest **one** improvement to the student's method.

_____

_____

_____

_____

(2)

(e) The table below shows the student's results.

	Temperature rise in °C			
Type of oil	**1**	**2**	**3**	**Mean**
Castor oil	20	19	21	20
Linseed oil	19	18	19	19
Mineral oil	21	21	21	21
Olive oil	17	17	18	
Sesame oil	23	23	20	22

Calculate the mean temperature rise for olive oil.

Give your answer to two significant figures.

_____

_____

_____

_____

Mean temperature rise = _____ °C

(2)

(f) The mean change in temperature of the castor oil is 20 °C

The specific heat capacity of castor oil is 1 800 J / kg °C

The mass of oil used is 0.025 kg

Calculate the change in thermal energy of the castor oil the student used.

Use the correct equation from the Physics Equations Sheet.

Select the correct unit from the box.

joule	**newton**	**volt**

_____

_____

_____

_____

_____

Change in thermal energy = _____

Unit = _____

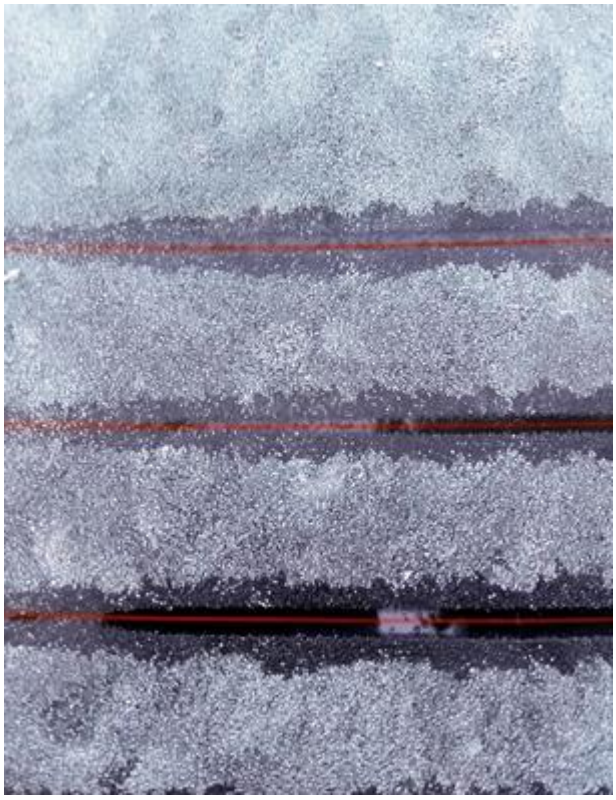
(3)

(Total 13 marks)

Q2.

Figure 1 shows solid ice on a car's rear window.

Figure 1

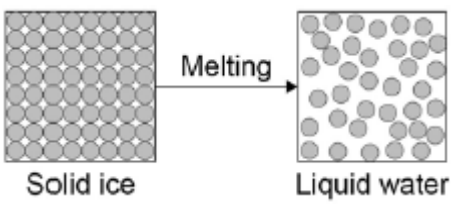


© Captive cookies/iStock/Thinkstock

The glass window contains an electrical heating element.

(a) Use the particle model in **Figure 2** to describe how the heating element causes the arrangement of the ice particles to change as the ice melts.

Figure 2



You should include a description of how the particles are arranged in the solid ice and in the water.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(b) A car manufacturer tests different heating elements by measuring how long it takes ice to melt.

During the test some variables must be controlled.

Identify **two** control variables in the car manufacturer's test.

Tick **two** boxes.

The colour of the car	☐
The current in the heating element	☐
The mass of ice	☐
The size of the car	☐
The time taken for the ice to melt	☐

(2)

(c) Some of the energy supplied by the heater causes the ice to melt without the temperature of the ice increasing.

What is the name given to this energy supplied by the heater?

Tick **one** box.

Latent heat of freezing	☐

Latent heat of fusion ☐

Latent heat of vaporisation ☐

(1)

(d) When the heater is supplied with 120 J of energy each second, the internal energy of the ice increases by 45 J each second.

Use the following equation to calculate the efficiency of the heater.

$$\text{Efficiency} = \frac{\text{Output energy transfer}}{\text{input energy transfer}}$$

Give your answer to two decimal places.

_____

_____

_____

Efficiency = _____

(2)

(Total 11 marks)

Q3.

Figure 1 shows a battery operated remote control car.

Figure 1

© Brandon Bolin/iStock/Thinkstock

(a) The car's battery contains a store of energy.

As the car moves, energy from one store is transferred to another store.

Describe how different stores of energy change as the car moves.

_____

_____

_____

_____

(2)

(b) The car has a top speed of 12 m / s and a mass of 800 g.

Write down the equation that links kinetic energy, mass and speed.

Equation _____

(1)

(c) Calculate the maximum kinetic energy of the car.

_____

_____

_____

Maximum kinetic energy = _____ J

(2)

(d) Explain why having a more efficient motor increases the top speed of the car.

_____

_____

_____

_____

(2)

(e) **Figure 2** shows an electric car being charged.

Figure 2

By Alan Trotter Electric Car Charging [CC-BY-2.0]via Flickr

A driver wishes to buy a new car.

The table below gives some data about an electric car and one with a petrol engine.

	Electric car	**Petrol engine car**
Cost (£)	27 000	15 000
Running cost per year (£)	250	2 000
Average lifetime (years)	12	12

Which car would be the most economic over its 12 year lifetime?

Use data from the table above to support your answer.

You should include the difference in cost in your answer.

(4)
(Total 11 marks)

Q4.

Figure 1 shows a kettle a student used to determine the specific heat capacity of water.

Figure 1

© vladimirkim3722/iStock/Thinkstock

The student placed different masses of water into the kettle and timed how long it took for the water to reach boiling point.

The student carried out the experiment three times.

The student's results are shown in the table below.

	Time for water to boil in seconds					
Mass of water in kg	**1**	**2**	**3**	**Mean**	**Mass × change in temperature in kg°C**	**Energy supplied in kJ**
0.25	55	60	63	59	20	131
0.50	105	110	116	110	40	243
0.75	140	148	141	143	60	314
1.00	184	190	183	182	80	401
1.25	216	215	211	214	100	471
1.50	272	263	266	267	120	587
1.75	298	300	302		140	

(a) Suggest how the student was able to ensure that the change in temperature was the same for each mass of water.

_____

(2)

(b) Calculate the uncertainty in the student's measurements of time to boil when the mass of water was 1.75 kg.

_____

_____

Uncertainty = _____ s

(2)

(c) The power rating of the kettle is 2.20 kW.

Calculate the average electrical energy used by the kettle, in kJ, for 1.75 kg of water to reach boiling point.

_____

_____

_____

Average energy = _____ kJ

(2)

(d) Use information from the table above to calculate the change in temperature of the water during the investigation.

_____

_____

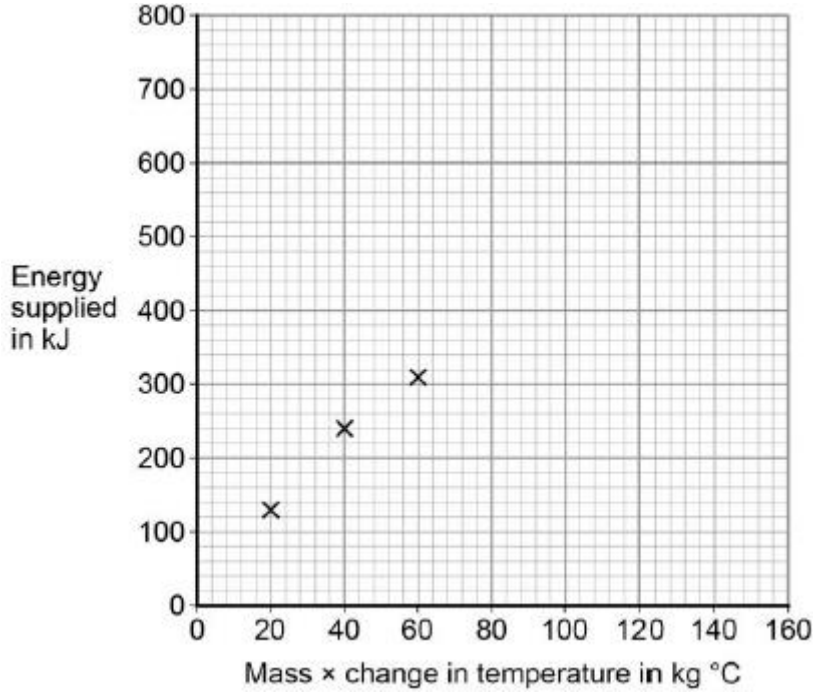
Change in temperature = _____ °C

(2)

(e) The student plotted a graph of energy supplied in kJ against mass × change in temperature in kg °C.

Figure 2 shows the graph the student plotted.

Figure 2



Use data from the table above to plot the four missing points.

Draw a line of best fit on the graph.

(3)

(f) Use the graph to determine the mean value of the specific heat capacity of water, for the student's investigation.

_____

_____

_____

_____

_____

Specific heat capacity of water = _____ J / kg °C

(4)

(g) The student's value for the specific heat capacity of water was greater than the accepted value.

Suggest why.

_____

_____

(1)

(h) The kettle used in the experiment had a label stating that the power rating of the kettle was 2.2 kW.

The student did not measure the power of the kettle.

Suggest why measuring the power of the kettle may improve the student's investigation.

_____

_____

(1)

(Total 17 marks)

Q5.

A student investigated the specific heat capacity of metals.

(a) Describe an experiment the student could do to measure the specific heat capacity of a metal.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(b) The student calculated the specific heat capacity of four metals.

The table below shows the student's results.

Metal	Mass of material in kg	Time in minutes	Temperature in °C	Change in thermal energy in J	Calculated specific heat capacity of material in J / kg °C
Aluminium	1	10	2	4 780	2 390
Brass	1	10	4	4 660	1 165
Copper	1	10		4 600	657
Steel	1	10	5	4 690	938

Use data from the table above to calculate the temperature change for copper.

Use the correct equation from the Physics Equation Sheet.

_____

_____

_____

_____

Temperature change = _____ °C

(3)

(c) What is the independent variable in the student's investigation?

Tick **one** box.

Mass of material ☐

Power used ☐

Time in minutes ☐

Type of material ☐

(1)

(d) The student calculated the specific heat capacity of aluminium to be 2390 J / kg °C.

The 'true' specific heat capacity of aluminium is 900 J / kg °C.

Suggest why the student's result for aluminium is different from the 'true' value.

_____

_____

_____

_____

(2)

(e) The teacher suggested that putting bubble wrap round the metal block would change the results.

How would using bubble wrap change the results?

Give a reason for your answer.

_____

_____

_____

_____

(2)

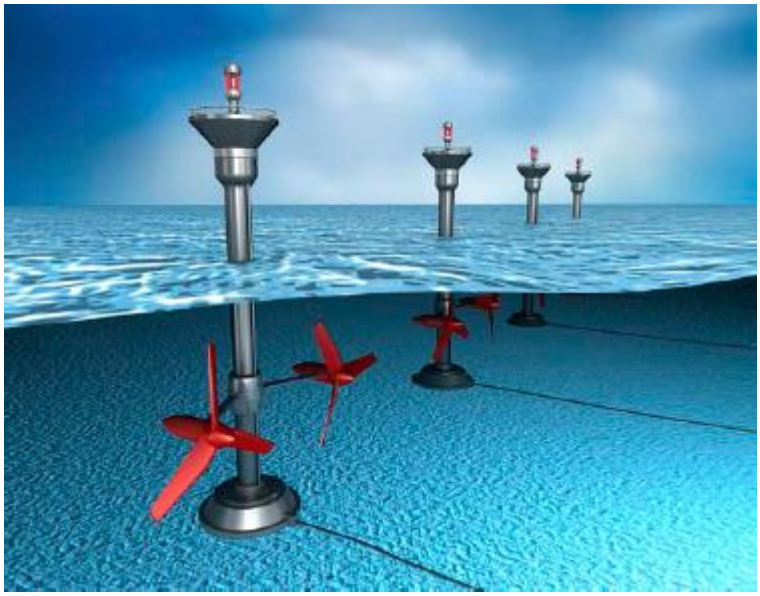
(Total 14 marks)

Q6.

Electricity in the UK is generated in many ways.

The figure below shows an undersea turbine.

The undersea turbine uses tidal energy to generate electricity.



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(a) What is the original source of energy for tidal power schemes?

_____

_____

(1)

(b) Explain **two** advantages of using undersea tidal turbines to generate electricity rather than burning fossil fuels.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Some power stations burn wood instead of fossil fuels to generate electricity.

A coal-burning power station burns 6 million tonnes of coal per year.

Coal has an average energy value of 29.25 MJ per kg.

Wood chip from willow trees has an energy value of 13 MJ per kg.

A hectare of agricultural land can produce 9 tonnes of dry willow wood per year.

If this power station burned dry willow wood instead of coal, how much agricultural land would be needed to grow the willow?

_____

_____

_____

_____

_____

Amount of land needed = _____ hectares

(3)

(d) The table below shows the carbon dioxide emissions of four fuels used to generate electricity.

Fuel	**Direct CO_2 emissions in kg per MWh**	**Lifecycle CO_2 emissions in kg per MWh**
Coal	460	540
Natural gas	185	215
Oil	264	313
Wood	2 100	58

Direct CO_2 emissions are the amounts of carbon dioxide released when the fuel is burned.

Lifecycle CO_2 emissions is the total amount of carbon dioxide released during all stages from fuel extraction to when the fuel has been used.

Use the data from the table above to explain why wood is considered to be a low carbon dioxide emitting fuel.

_____

_____

_____

_____

_____

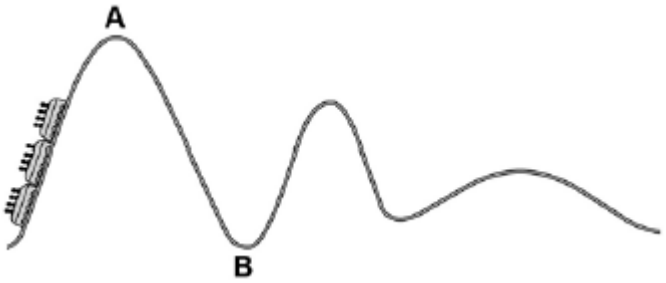
_____

(2)

(Total 10 marks)

Q7.

The figure below shows a rollercoaster.



The rollercoaster car is raised a vertical distance of 35 m to point **A** by a motor in 45 seconds.

The mass of the rollercoaster is 600 kg.

The motor has a power rating of 8 000 W.

(a) Calculate the percentage efficiency of the motor.

Gravitational field strength = 9.8 N / kg.

_____

_____

_____

_____

_____

_____

_____

Efficiency = _____ %

(5)

(b) The rollercoaster rolls from point **A** to point **B**, a drop of 35 m.

Calculate the speed of the roller coaster at point **B**.

Assume that the decrease in potential energy store is equal to the increase in kinetic energy store.

_____

_____

_____

_____

_____

_____

_____

Speed at point **B** = _____ m / s

(6)

(Total 11 marks)

Q8.

A student finds some information about energy-saving light bulbs.

(a) A 30W light bulb uses 600J of electrical energy in a certain period of time. In that time, it produces 450 J of light energy. The rest of the energy is wasted.

(i) Calculate the energy wasted by the light bulb in this period of time.

_____

Wasted energy = _____ J

(1)

(ii) What happens to the energy wasted by the light bulb?

_____

_____

(1)

(iii) Calculate the efficiency of this light bulb.

_____

_____

Efficiency = _____

(2)

(iv) Calculate the period of time, in seconds, during which the 600 J is provided to the 30 W light bulb.

_____

_____

Time = _____ s

(2)

(b) A company that makes light bulbs provides information about some of their products.

The table shows some of this information.

	Power in watts	**Lifetime in hours**	**Cost of bulb in £**
Filament bulb	60	1250	2.00
LED bulb	12	50 000	16.00

(i) Suggest why it is important to confirm this information independently.

_____

(1)

(ii) A homeowner is thinking about replacing his filament bulbs with LED bulbs.

A 12 W LED bulb gives the same light output as a 60 W filament bulb.

Suggest reasons why the homeowner is likely to choose LED bulbs.

Use the information given in the table.

_____

_____

_____

_____

(2)

(iii) State **one** factor, other than efficiency, that is important when considering the choice of a bulb for lighting in the home.

_____

_____

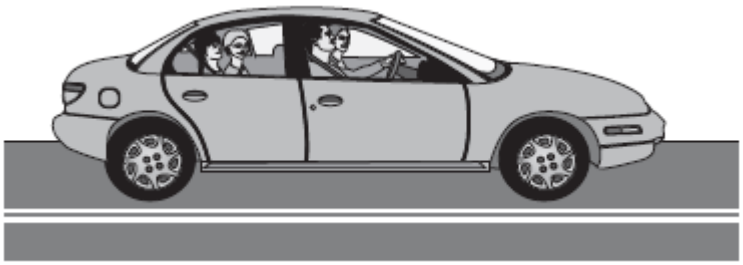
(1)

(Total 10 marks)

Q9.

The figure below shows a car with an electric motor.

The car is moving along a flat road.



(a) (i) Use the correct answers from the box to complete each sentence.

light	**electrical**	**kinetic**	**potential**	**sound**

The car's motor transfers _____ energy

into useful _____ energy as the car moves.

Some energy is wasted as _____ energy.

(3)

(ii) What happens to the wasted energy?

_____

_____

(1)

(b) The electric motor has an input energy of 50 000 joules each second.

The motor transfers 35 000 joules of useful energy each second.

Calculate the efficiency of the electric motor.

_____

_____

_____

Efficiency = _____

(2)

(Total 6 marks)

Q10.

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)

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.

(a) Iceland is a country that generates nearly all of its electricity from renewable sources.

In 2013, about 80% of Iceland's electricity was generated using hydroelectric power stations (HEP).

Describe how electricity is generated in a hydroelectric power station. Include the useful energy transfers taking place.

(4)

(b) The UK produces most of its electricity from fossil fuels.

Many people in the UK leave their televisions in 'stand by' mode when not in use, instead of switching them off.

It is better for the environment if people switch off their televisions, instead of leaving them in 'stand by' mode.

Explain why.

(3)

(c) A scientist wrote in a newspaper:

‘Appliances that do not automatically switch off when they are not being used should be banned.’

Suggest why scientists alone cannot make the decision to ban these appliances.

_____

_____

(1)

(Total 8 marks)

Q13.

Table 1 shows information about different light bulbs.

The bulbs all have the same brightness.

Table 1

Type of bulb	Input power in watts	Efficiency
Halogen	40	0.15
Compact fluorescent (CFL)	14	0.42
LED	7	0.85

(a) (i) Calculate the useful power output of the CFL bulb.

_____

_____

_____

Useful power output = _____ watts

(2)

(ii) Use your answer to part **(i)** to calculate the waste energy produced each second by a CFL bulb.

_____

Waste energy per second = _____ joules

(1)

(b) (i) A growth cabinet is used to investigate the effect of light on the rate of growth of plants.

The figure below shows a growth cabinet.

In the cabinet the factors that affect growth can be controlled.

A cooler unit is used to keep the temperature in the cabinet constant. The cooler unit is programmed to operate when the temperature rises above 20 °C.

The growth cabinet is lit using 50 halogen bulbs.

Changing from using halogen bulbs to LED bulbs would reduce the cost of running the growth cabinet.

Explain why.

_____

_____

_____

_____

_____

_____

(4)

(ii) A scientist measured the rate of growth of plants for different intensities of light.

What type of graph should be drawn to present the results?

_____

Give a reason for your answer.

_____

_____

(1)

(c) **Table 2** gives further information about both a halogen bulb and a LED bulb.

Table 2

Type of	Cost to	Lifetime in	Operating cost over the

bulb	buy	hours	lifetime of one bulb
Halogen	£1.50	2 000	£16.00
LED	£30.00	48 000	£67.20

A householder needs to replace a broken halogen light bulb.

Compare the cost efficiency of buying and using halogen bulbs rather than a LED bulb over a time span of 48 000 hours of use.

Your comparison must include calculations.

(4)

(Total 12 marks)

Q14.

Solar panels are often seen on the roofs of houses.

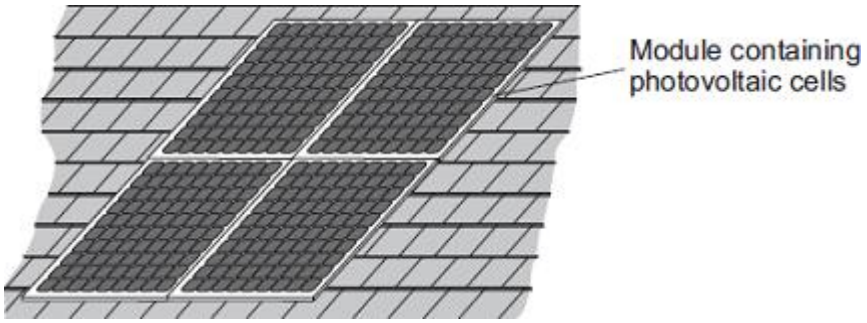
(a) Describe the action and purpose of a solar panel.

(2)

(b) Photovoltaic cells transfer light energy to electrical energy.

In the UK, some householders have fitted modules containing photovoltaic cells on the roofs of their houses.

Four modules are shown in the diagram.



The electricity company pays the householder for the energy transferred.

The maximum power available from the photovoltaic cells shown in the diagram is 1.4×10^3 W.

How long, in minutes, does it take to transfer 168 kJ of energy?

_____

_____

_____

_____

_____

_____ Time = _____ minutes

(3)

(c) When the modules are fitted on a roof, the householder gets an extra electricity meter to measure the amount of energy transferred by the photovoltaic cells.

(i) The diagram shows two readings of this electricity meter taken three months apart.
The readings are in kilowatt-hours (kWh).

21 November	0	0	0	4	4
21 February	0	0	1	9	4

Calculate the energy transferred by the photovoltaic cells during this time period.

_____

Energy transferred = _____ kWh

(1)

(ii) The electricity company pays 40p for each kWh of energy transferred.

Calculate the money the electricity company would pay the householder.

_____

_____

Money paid = _____

(2)

(iii) The cost of the four modules is £6000.

Calculate the payback time in years for the modules.

_____

_____

Payback time = _____ years

(3)

(iv) State an assumption you have made in your calculation in part **(iii)**.

_____

_____

(1)

(d) In the northern hemisphere, the modules should always face south for the maximum transfer of energy.

State **one** other factor that would affect the amount of energy transferred during daylight hours.

_____

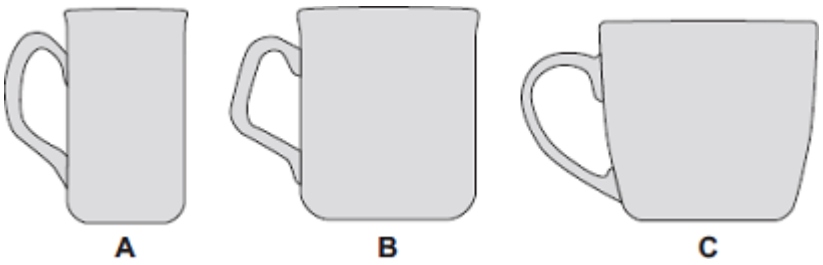
_____

(1)

(Total 13 marks)

Q15.

The diagram shows three cups **A**, **B** and **C**.

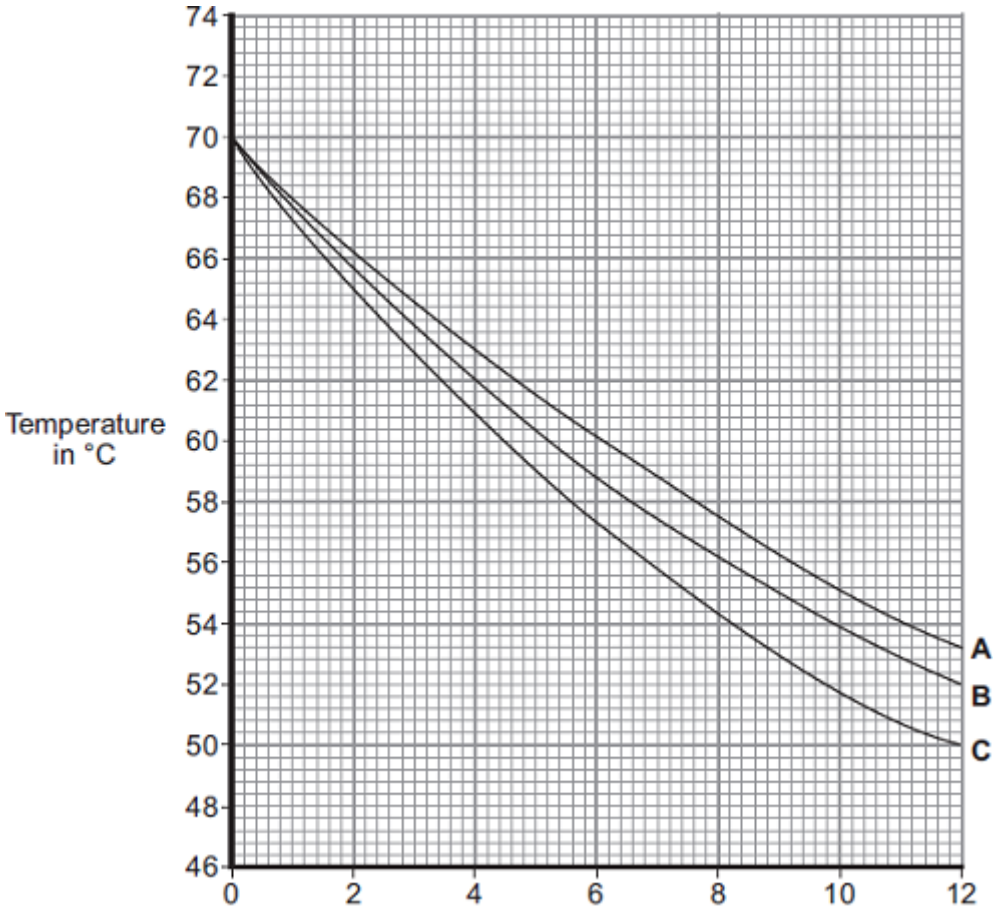


Energy is transferred from hot water in the cups to the surroundings.

(a) Some students investigated how the rate of cooling of water in a cup depends on the surface area of the water in contact with the air.

They used cups **A**, **B** and **C**. They poured the same volume of hot water into each cup and recorded the temperature of the water at regular time intervals.

The results are shown on the graph.



(i) What was the starting temperature of the water for each cup?

Starting temperature = _____ °C

(1)

(ii) Calculate the temperature fall of the water in cup **B** in the first 9 minutes.

_____

Temperature fall = _____ °C

(2)

(iii) Which cup, **A**, **B** or **C**, has the greatest rate of cooling? ☐

Using the graph, give a reason for your answer.

_____

_____

(2)

(iv) The investigation was repeated using the bowl shown in the diagram.

The same starting temperature and volume of water were used.

Draw on the graph in part **(b)** another line to show the expected result.

(1)

(v) After 4 hours, the temperature of the water in each of the cups and the bowl was 20°C.

Suggest why the temperature does **not** fall below 20°C.

_____

(1)

(b) (i) The mass of water in each cup is 200 g.

Calculate the energy, in joules, transferred from the water in a cup when the temperature of the water falls by 8°C.

Specific heat capacity of water = 4200 J / kg°C.

_____

_____

_____

Energy transferred = _____ J

(3)

(ii) Explain, in terms of particles, how evaporation causes the cooling of water.

_____

_____

_____

_____

_____

_____

_____

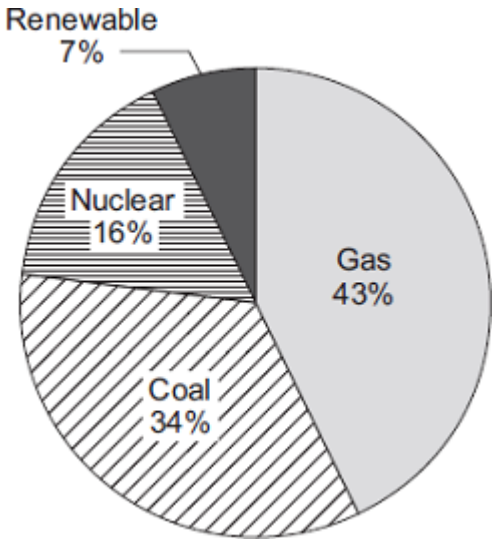
_____

(4)

(Total 14 marks)

Q16.

(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. ☐

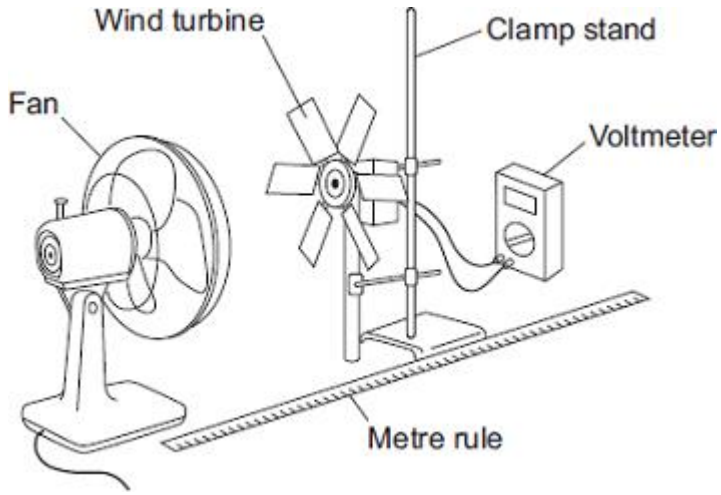
(1)

(Total 4 marks)

Q17.

(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.

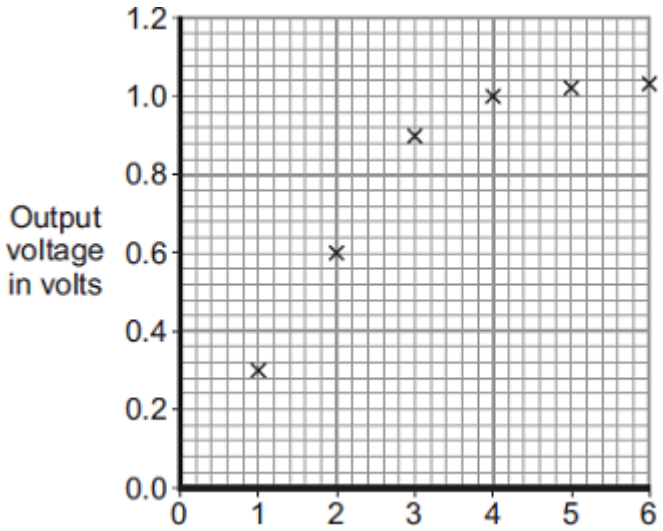
_____

_____

(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?

_____

_____

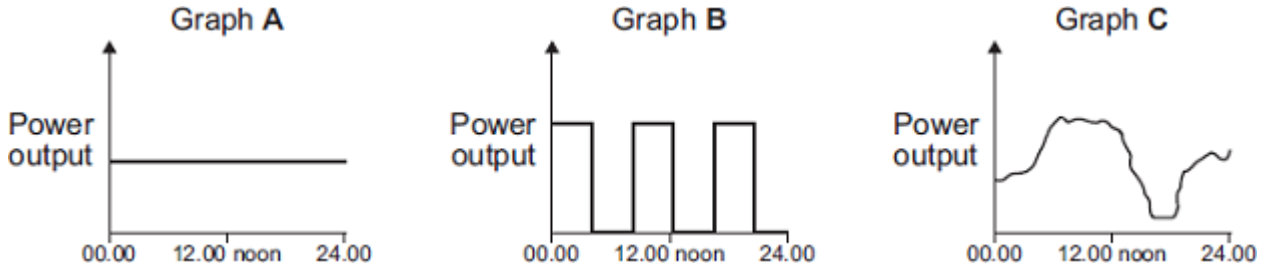
_____

_____

(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.

_____

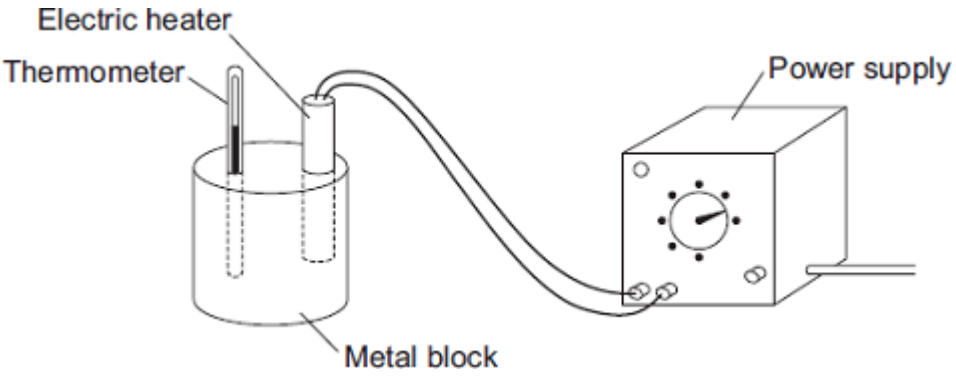
_____

_____

(2)
(Total 6 marks)

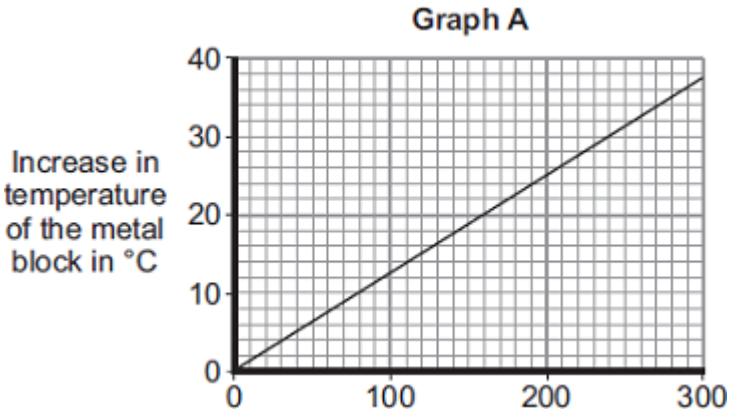
Q18.

(a) A student used the apparatus drawn below to investigate the heating effect of an electric heater.



(i) Before starting the experiment, the student drew **Graph A**.

Graph A shows how the student expected the temperature of the metal block to change after the heater was switched on.



Describe the pattern shown in **Graph A**.

_____

_____

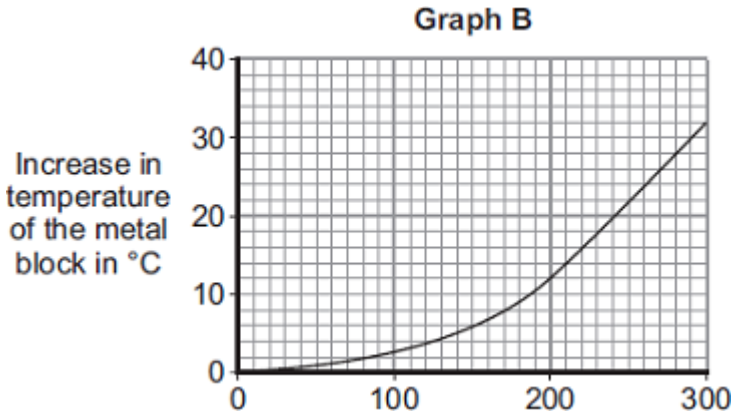
_____

_____

(2)

(ii) The student measured the room temperature. He then switched the heater on and measured the temperature of the metal block every 50 seconds.

The student calculated the increase in temperature of the metal block and plotted **Graph B**.



After 300 seconds, **Graph B** shows the increase in temperature of the metal block is lower than the increase in temperature expected from **Graph A**.

Suggest **one** reason why.

_____

_____

(1)

(iii) The power of the electric heater is 50 watts.

Calculate the energy transferred to the heater from the electricity supply in 300 seconds.

_____

_____

_____

Energy transferred = _____ J

(2)

(b) The student uses the same heater to heat blocks of different metals. Each time the heater is switched on for 300 seconds.

Each block of metal has the same mass but a different specific heat capacity.

Metal	Specific heat capacity in J/kg°C
Aluminium	900
Iron	450
Lead	130

Which **one** of the metals will heat up the most?

Draw a ring around the correct answer.

aluminium **iron** **lead**

Give, in terms of the amount of energy needed to heat the metal blocks, a reason for your answer.

_____

_____

_____

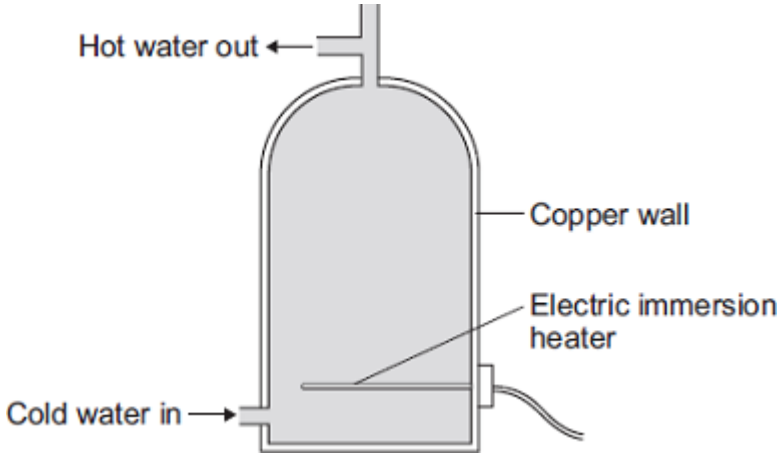
_____

(2)

(Total 7 marks)

Q19.

An electric immersion heater is used to heat the water in a domestic hot water tank. When the immersion heater is switched on the water at the bottom of the tank gets hot.



(a) Complete the following sentence.

The main way the energy is transferred through the copper wall of the water tank is

by the process of _____ .

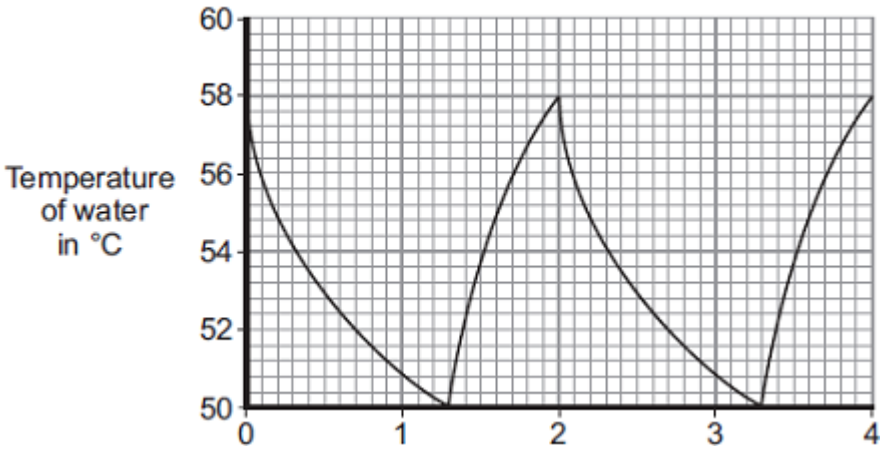
(1)

(b) The immersion heater has a thermostat to control the water temperature.

When the temperature of the water inside the tank reaches 58°C the thermostat switches the heater off. The thermostat switches the heater back on when the temperature of the water falls to 50°C.

Graph A shows how the temperature of the water inside a hot water tank changes with time. The tank is **not** insulated.

Graph A (no insulation)



(i) The temperature of the water falls at the fastest rate just after the heater switches off.

Explain why.

_____

_____

_____

_____

(2)

(ii) To heat the water in the tank from 50°C to 58°C the immersion heater transfers 4032 kJ of energy to the water.

Calculate the mass of water in the tank.

Specific heat capacity of water = 4200 J/kg°C

_____

_____

_____

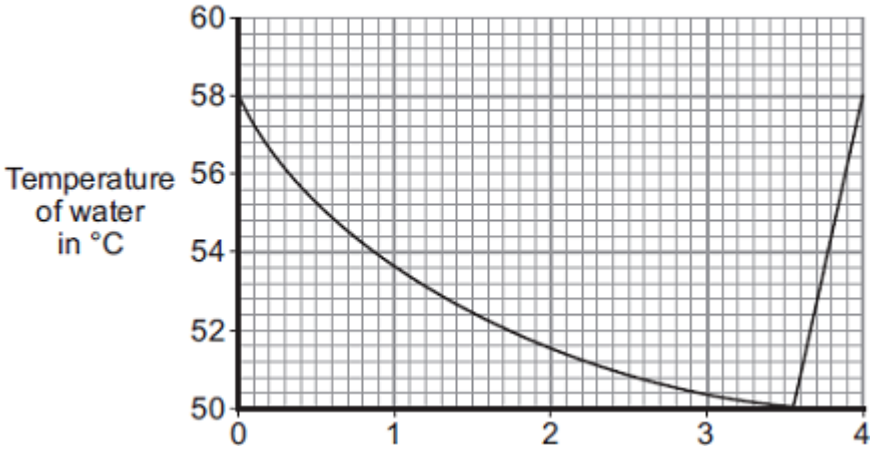
Mass = _____ kg

(3)

(iii) An insulating jacket is fitted to the hot water tank.

Graph B shows how the temperature of the water inside the insulated hot water tank changes with time.

Graph B



An insulating jacket only costs £12.

By comparing **Graph A** with **Graph B**, explain why fitting an insulating jacket to a hot water tank saves money.

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

Q20.

(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)

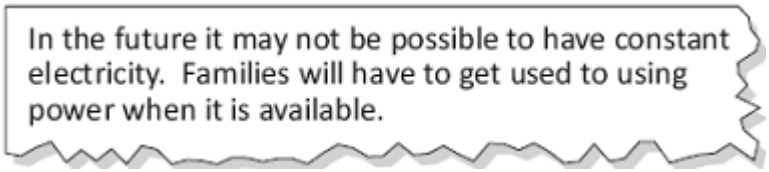
(ii) Give **one** other advantage of a pumped storage hydroelectric power station.

_____

_____

(1)

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



(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)

Q21.

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**.

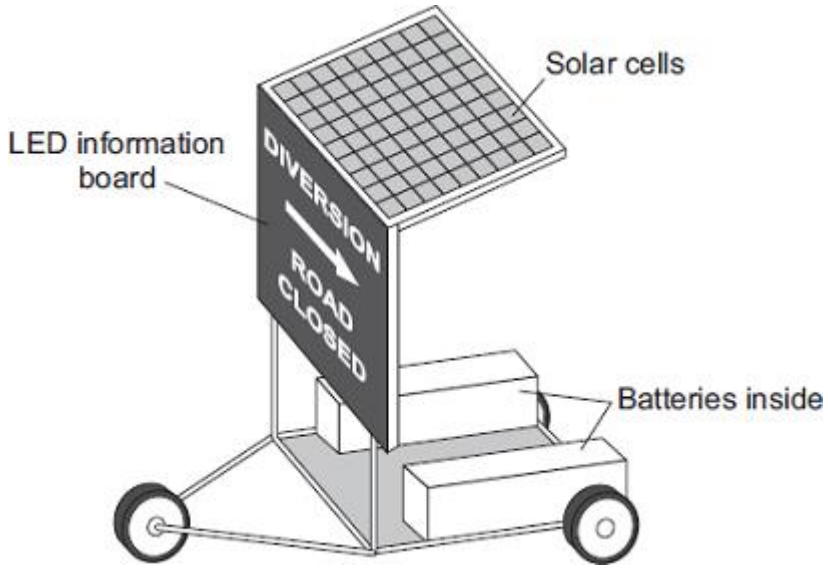
Draw **one** line from each energy source in **List A** to the statement about the energy source in **List B**.

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

(Total 3 marks)

Q22.

The picture shows a temporary road traffic information board.



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

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

chemical	electrical	light	sound

The solar cells transfer light energy to _____ energy.

The batteries transfer _____ energy to electrical energy.

The LEDs transfer electrical energy to _____ energy.

(3)

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

Calculate the efficiency of the solar cells.

_____

_____

_____

Efficiency = _____

(2)

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

Tick (✓) **one** box.

Solar cells will charge the batteries day and night. ☐

The information board can be used anywhere it is needed. ☐

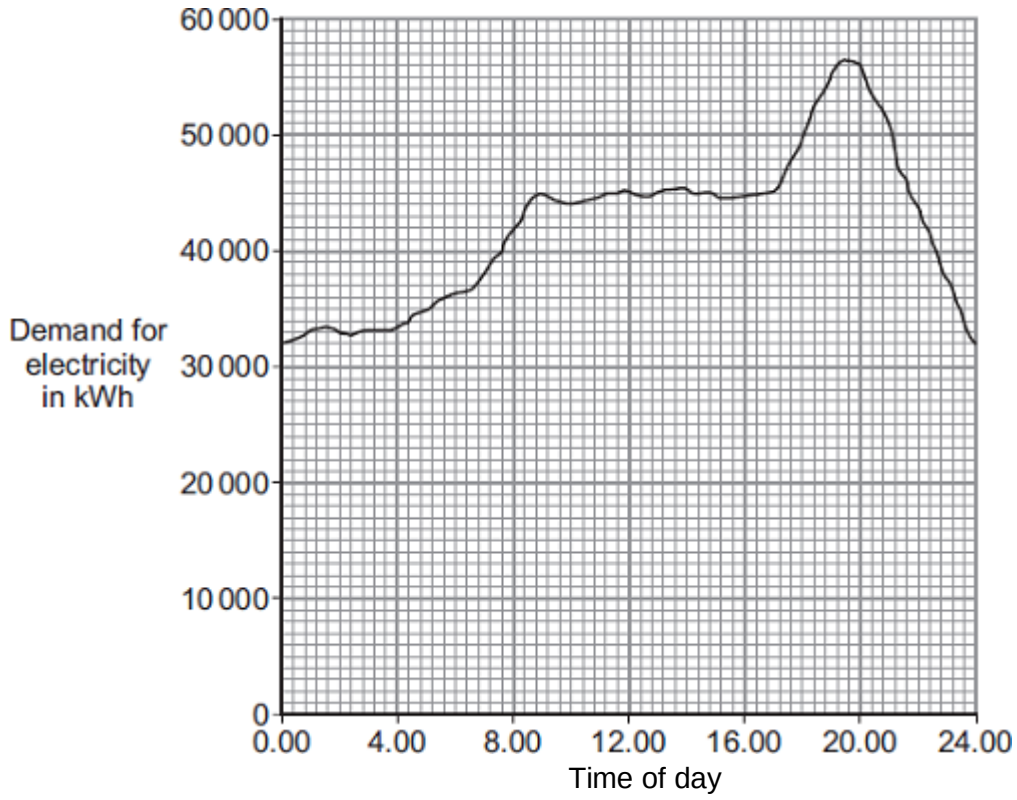
A small number of solar cells produce a lot of electricity. ☐

(1)

(Total 6 marks)

Q23.

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



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

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

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

(3)

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

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

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

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

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

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

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

_____

_____

_____

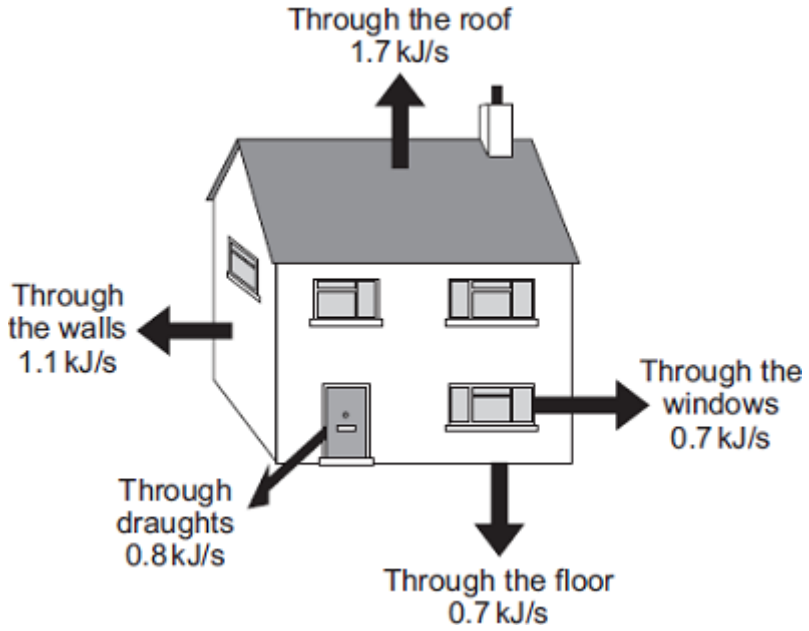
(6)

(Total 9 marks)

Q24.

Diagram 1 shows the energy transferred per second from a badly insulated house on a cold day in winter.

Diagram 1



(a) (i) When the inside of the house is at a constant temperature, the energy transferred from the heating system to the inside of the house equals the energy transferred from the house to the outside.

Calculate, in kilowatts, the power of the heating system used to keep the inside of the house in **Diagram 1** at a constant temperature.

1 kilowatt (kW) = 1 kilojoule per second (kJ/s)

_____

Power of the heating system = _____ kW

(1)

(ii) In the winter, the heating system is switched on for a total of 7 hours each day.

Calculate, in kilowatt-hours, the energy transferred each day from the heating system to the inside of the house.

_____

_____

Energy transferred each day = _____ kWh

(2)

(iii) Energy costs 15 p per kilowatt-hour.

Calculate the cost of heating the house for one day.

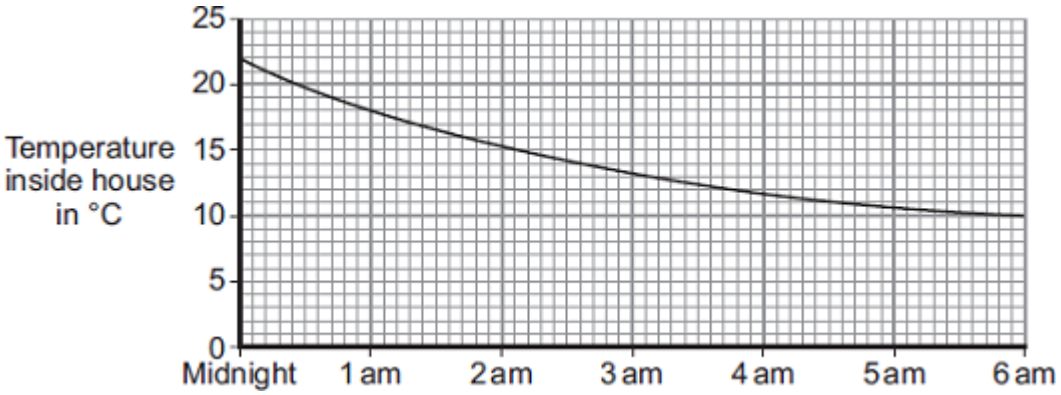
_____

Cost = _____

(1)

(iv) The heating system is switched off at midnight.

The graph shows how the temperature inside the house changes after the heating system has been switched off.



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

Between midnight and 6 am the rate of energy transfer from

	decreases.
the house	decreases then stays constant.
	increases.

Give the reason for your answer.

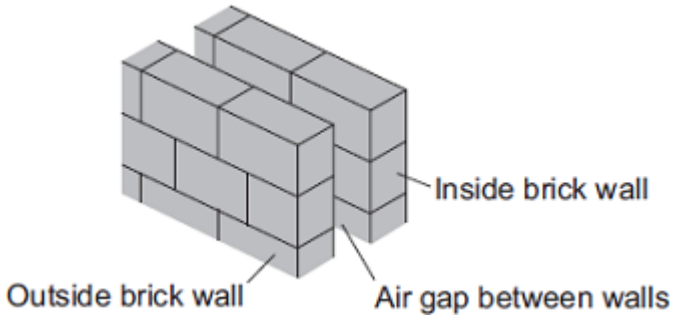
_____

_____

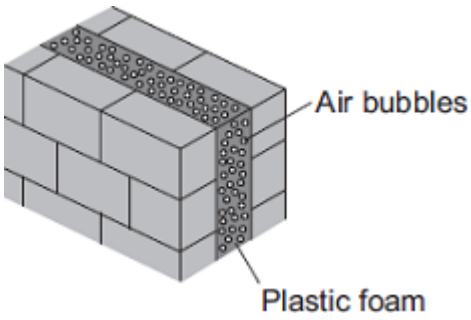
(2)

(b) **Diagram 2** shows how the walls of the house are constructed.
Diagram 3 shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

Diagram 2 **Diagram 3**



U-value of the wall = 0.7



U-value of the wall = 0.3

The plastic foam reduces energy transfer by convection.

Explain why.

_____

_____

_____

_____

(2)

(Total 8 marks)

Q25.

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.

_____

_____

_____

_____

_____

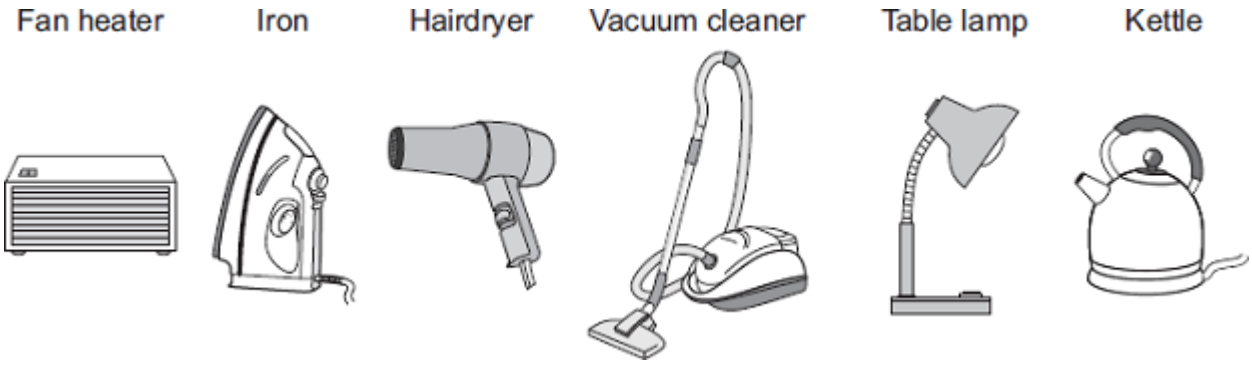
_____

(3)

(Total 7 marks)

Q26.

The pictures show six different household appliances.



(a) Four of the appliances, including the fan heater, are designed to transform electrical energy into heat.

Name the other **three** appliances designed to transform electrical energy into heat.

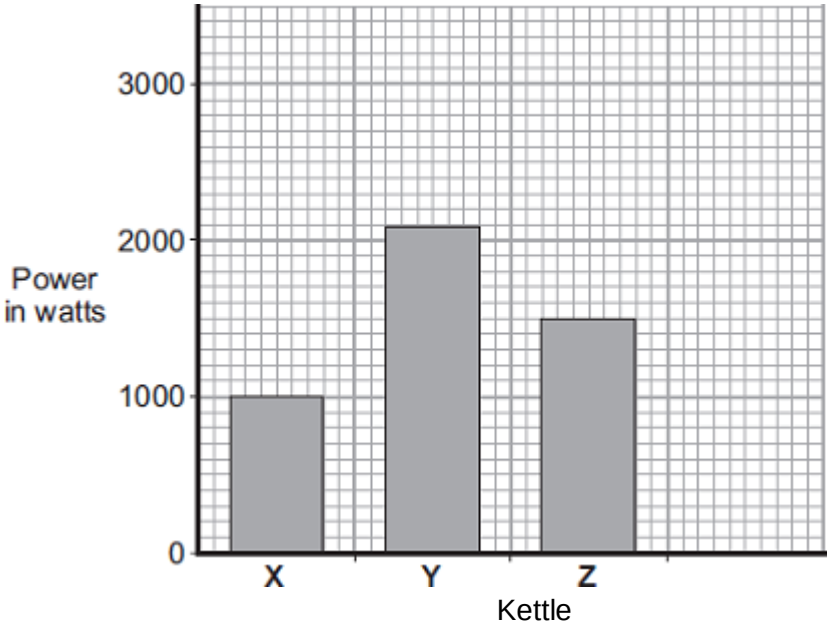
1. _____

2. _____

3 _____

(3)

(b) The bar chart shows the power of three electric kettles, **X**, **Y** and **Z**.



(i) In one week, each kettle is used for a total of 30 minutes.

Which kettle costs the most to use?

Put a tick (✓) next to your answer.

X ☐

Y ☐

Z ☐

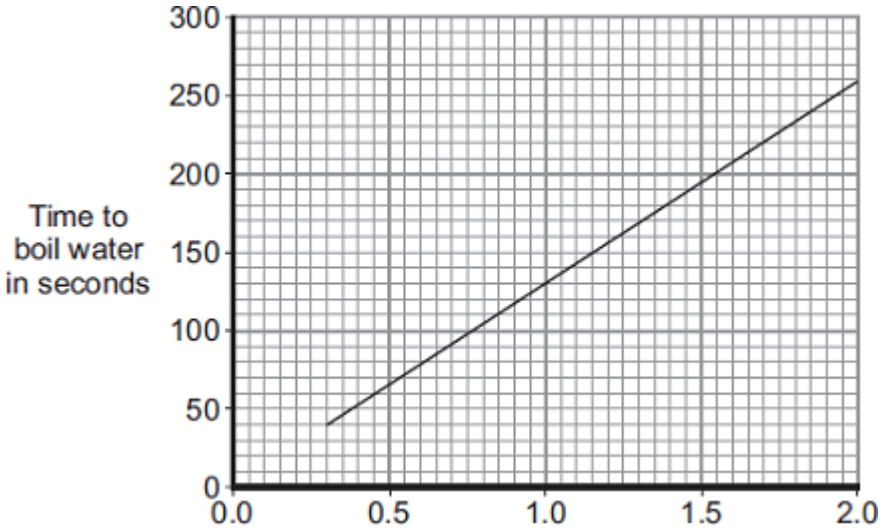
(1)

(ii) A new 'express boil' kettle boils water faster than any other kettle.

Draw a fourth bar on the chart to show the possible power of an 'express boil' kettle.

(1)

(c) The graph shows how the time to boil water in an electric kettle depends on the volume of water in the kettle.



A householder always fills the electric kettle to the top, even when only enough boiling water for one small cup of coffee is wanted.

Explain how the householder is wasting money.

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

Q27.

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)

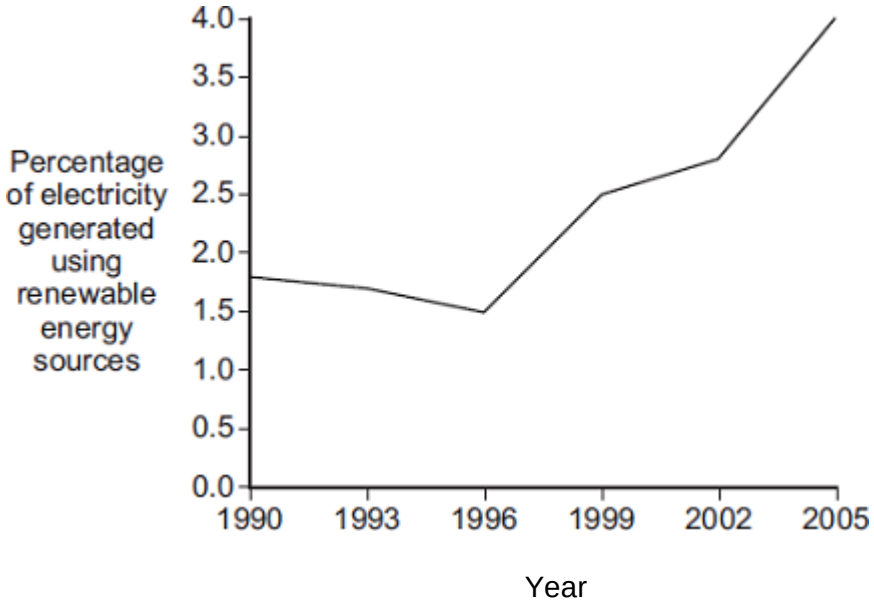
(b) If wood is to be used as a renewable energy source, what must be done each time a tree is chopped down?

_____

_____

(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)

Q28.

The picture shows a solar-powered aircraft. The aircraft has no pilot.

By NASA/Nick Galante [Public domain], via Wikimedia Commons

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

electrical	**heat**	**light**	**sound**

Solar cells are designed to transform _____ energy

into _____ energy.

(2)

(b) On a summer day, 175 000 joules of energy are supplied to the aircraft's solar cells every second. The useful energy transferred by the solar cells is 35 000 joules every second.

Use the equation in the box to calculate the efficiency of the solar cells.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

_____

_____

Efficiency = _____

(2)

(c) The aircraft propellers are driven by electric motors.

Give **one** environmental advantage of using electric motors to drive the aircraft propellers rather than motors that burn a fuel.

_____

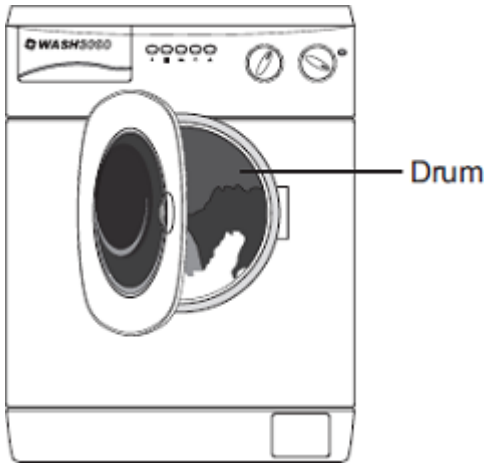
_____

(1)

(Total 5 marks)

Q29.

The picture shows a washing machine. When the door is closed and the machine switched on, an electric motor rotates the drum and washing.



(a) Complete the following sentences.

(i) An electric motor is designed to transform electrical energy into

_____ energy.

(1)

(ii) Some of the electrical energy supplied to the motor is wasted as

_____ energy and _____ energy.

(1)

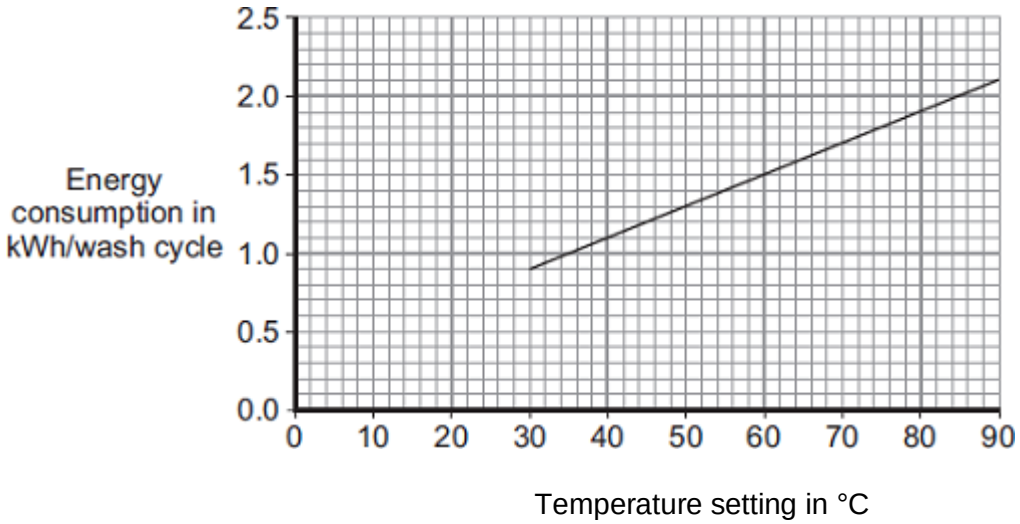
(b) What happens to the energy wasted by the electric motor?

_____

_____

(1)

(c) The graph shows that washing clothes at a lower temperature uses less energy than washing them at a higher temperature. Using less energy will save money.



(i) Electricity costs 15p per kilowatt-hour (kWh).

The temperature setting is turned down from 40 °C to 30 °C.

Use the graph and equation in the box to calculate the money saved each wash cycle.

total cost = number of kilowatt-hours x cost per kilowatt-hour

Show clearly how you work out your answer.

_____

_____

Money saved = _____

(2)

(ii) Reducing the amount of energy used by washing machines could reduce the amount of carbon dioxide emitted into the atmosphere.

Explain why.

_____

_____

_____

_____

(2)

(Total 7 marks)

Q30.

(a) Solar energy is a *renewable* energy source used to generate electricity.

(i) What is meant by an energy source being *renewable?*

_____

_____

(1)

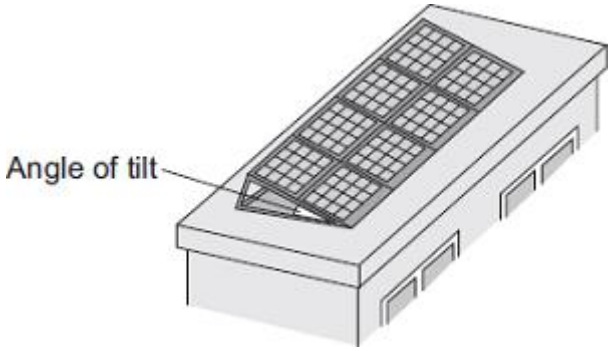
(ii) Name **two** other renewable energy sources used to generate electricity.

1. _____

2. _____

(1)

(b) A householder uses panels of solar cells to generate electricity for his home. The solar cells are tilted to receive the maximum energy input from the Sun.



The data in the table gives the average energy input each second (in J/s), to a 1 m^2 area of solar cells for different angles of tilt and different months of the year.

Month	**Angle of tilt**			
	20°	30°	40°	50°
February	460	500	480	440
April	600	620	610	600
June	710	720	680	640
August	640	660	640	580
October	480	520	500	460
December	400	440	420	410

(i) Use the data in the table to describe how the average energy input to the solar cells depends on the angle of tilt.

_____

_____

_____

_____

(2)

(ii) The total area of the solar cell panels used by the householder is 5 m^2.

The efficiency of the solar cells is 0.18.

Calculate the average **maximum** electrical energy available from the solar cell panels each second in June.

Show clearly how you work out your answer.

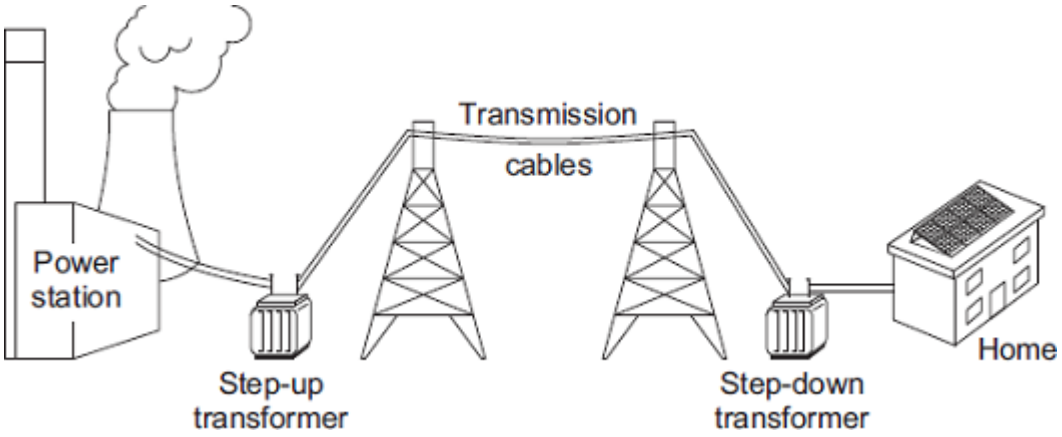
_____

_____

Maximum energy = _____ joules/second

(3)

(c) The diagram shows part of the National Grid.



(i) Even though the householder uses solar cells to generate electricity for his home, the home stays connected to the National Grid.

Give **one** reason why the householder should stay connected to the National Grid.

_____

_____

(1)

(ii) The step-up transformer increases the efficiency of the National Grid.

Explain how.

_____

_____

_____

_____

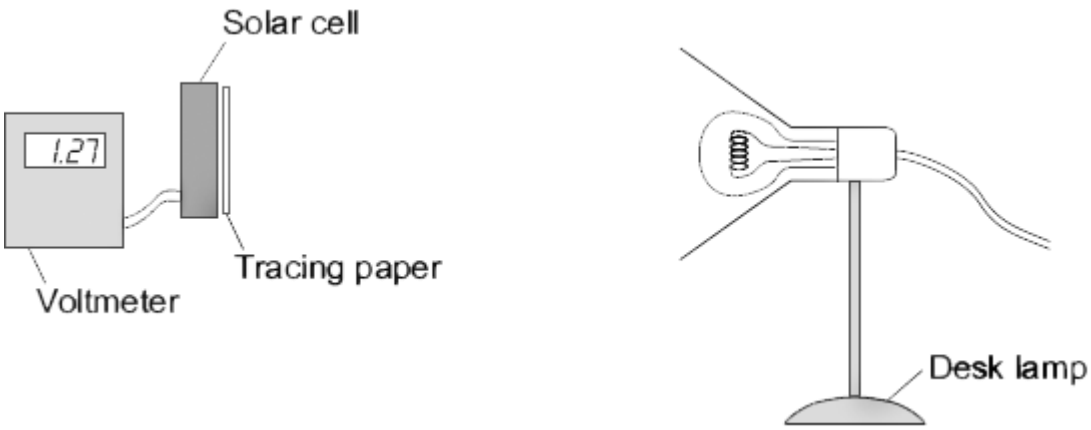
(2)

(Total 10 marks)

Q31.

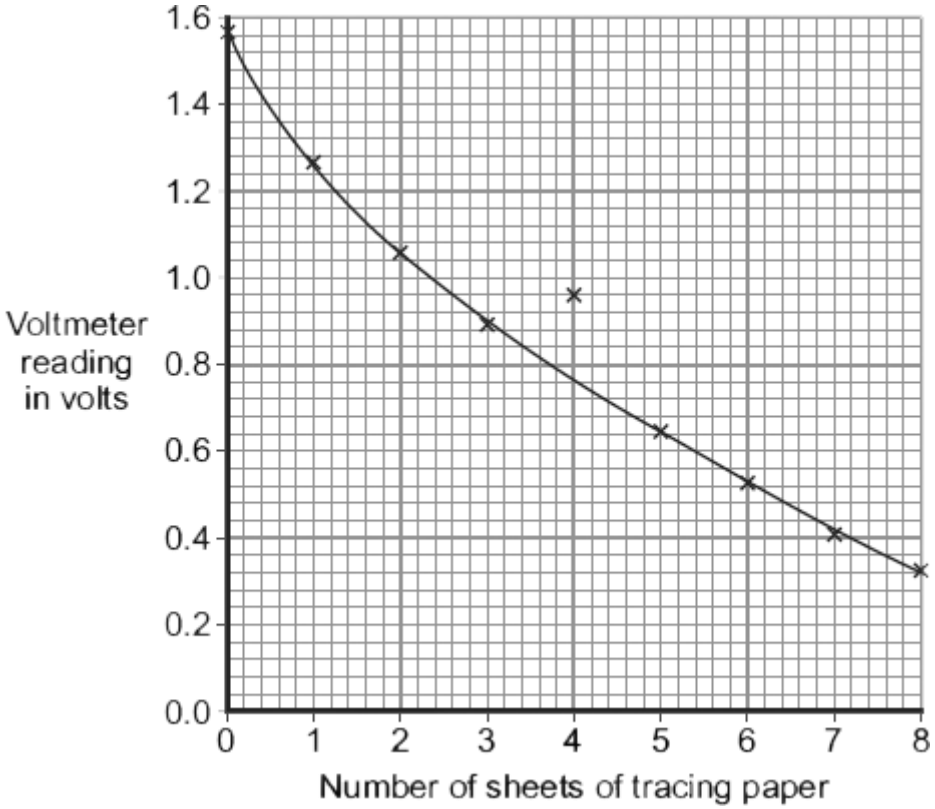
A student has read that a solar cell with a dirty surface will not work as well as a solar cell with a clean surface.

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

a decrease in

causes	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).

_____

_____

_____

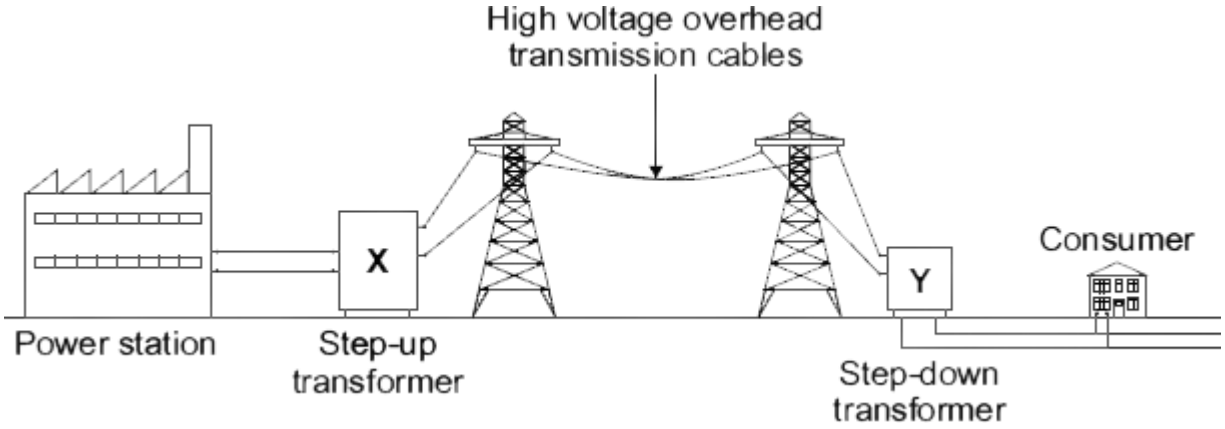
_____

(2)

(Total 8 marks)

Q32.

The diagram shows the National Grid system.



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

Explain why.

_____

_____

_____

_____

(2)

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

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

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

_____

_____

_____

_____

_____

_____

_____

_____

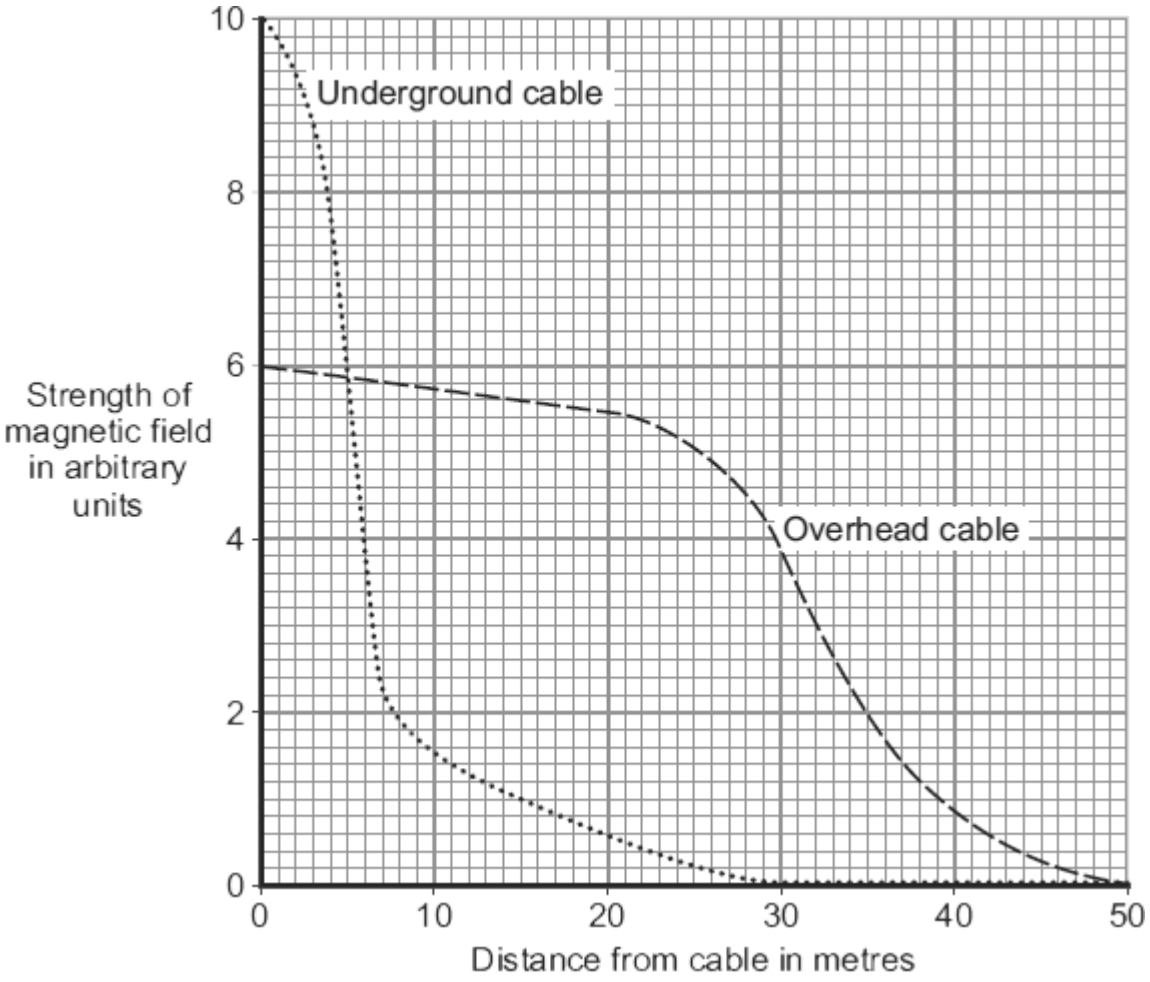
_____

_____

(6)

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

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



What conclusions may be drawn from this graph?

(2)

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

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

Using animals in scientific research raises

economic
environmental
ethical

issues.

(1)

(Total 11 marks)

Q33.

The table gives data about two types of low energy bulb.

Type of bulb	Power input in watts	Efficiency	Lifetime in hours	Cost of one bulb
Compact Fluorescent Lamp (CFL)	8	20%	10 000	£3.10
Light Emitting Diode (LED)	5		50 000	£29.85

(a) Both types of bulb produce the same useful power output.

(i) Calculate the useful power output of the CFL.

Show clearly how you work out your answer.

_____

_____

_____

Useful power output = _____ W

(2)

(ii) Calculate the efficiency of the LED bulb.

Show clearly how you work out your answer.

_____

_____

_____

Efficiency = _____

(1)

(b) LED bulbs are expensive. This is because of the large number of individual electronic LED chips needed to produce sufficient light from each bulb.

(i) Use the data in the table to evaluate the cost-effectiveness of an LED bulb compared to a CFL.

_____

_____

_____

_____

(2)

(ii) Scientists are developing brighter and more efficient LED chips than those currently used in LED bulbs.

Suggest **one** benefit of developing brighter and more efficient LED chips.

_____

_____

(1)

(Total 6 marks)

Q34.

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.

_____

_____

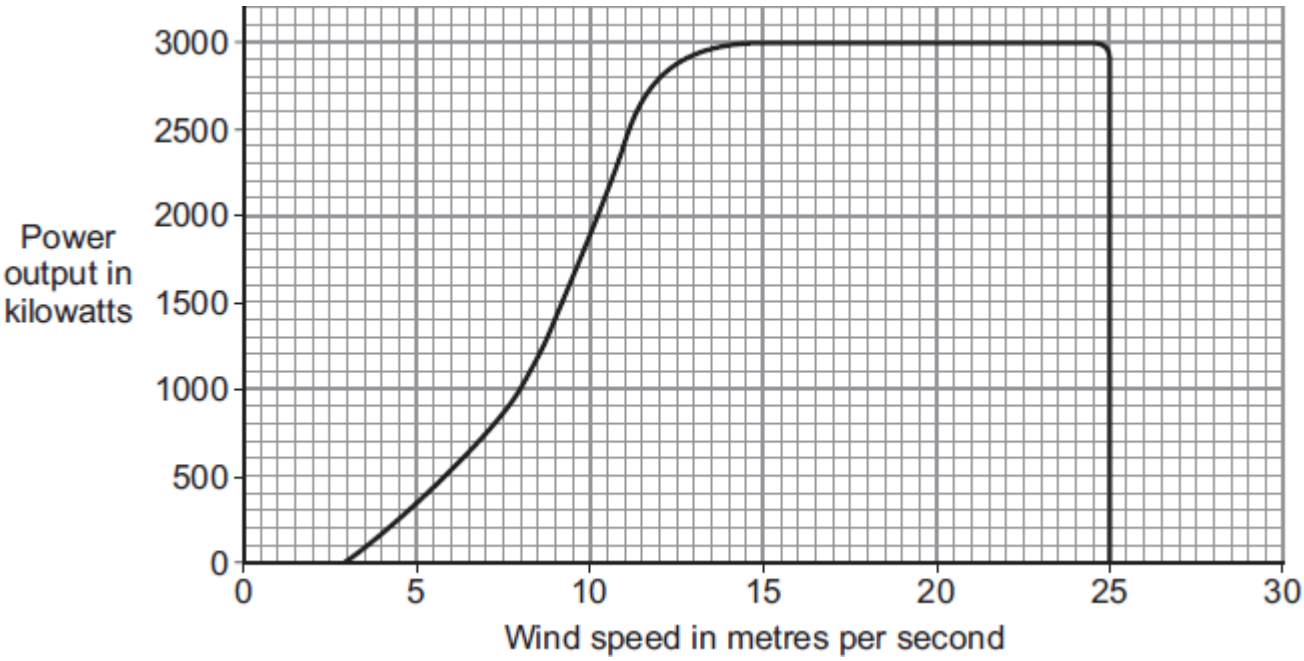
(1)

(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. ☐

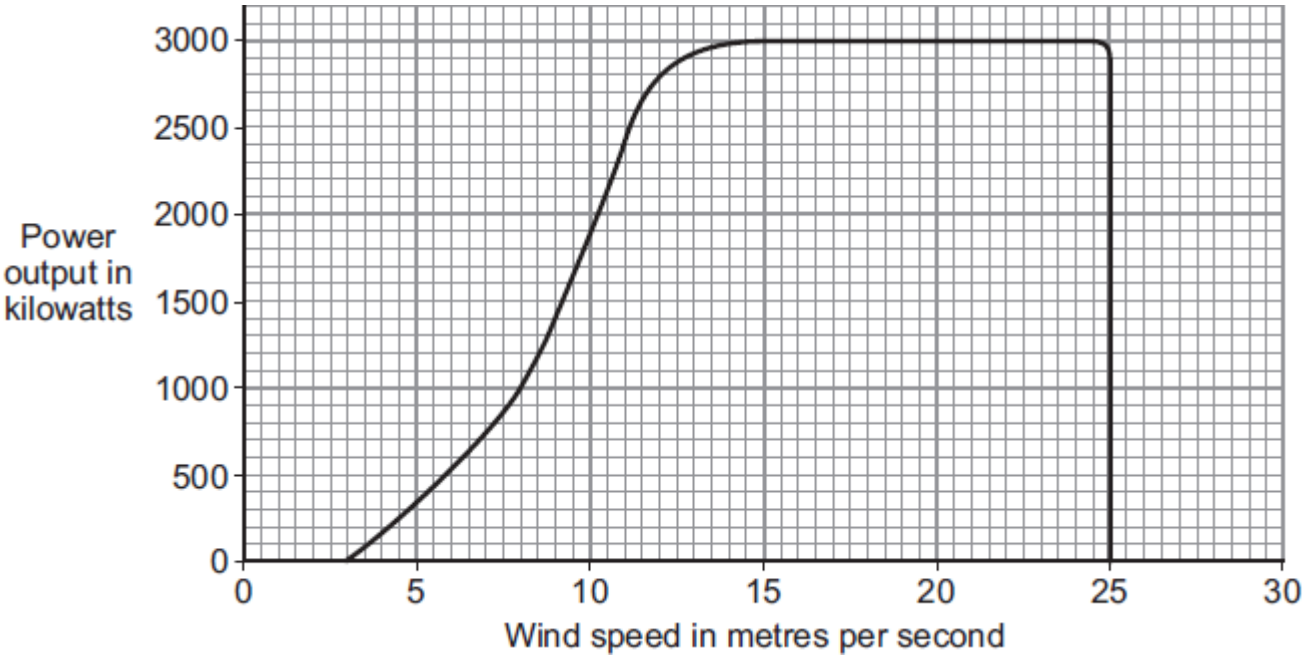
(1)

(Total 6 marks)

Q35.

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

(a) The graph shows how wind speed affects the power output from one of the wind turbines.



In one 4-hour period, the wind turbine transfers 5600 kilowatt-hours of electrical energy.

Use the data in the graph to calculate the average wind speed during this 4-hour period.

Show clearly how you work out your answer.

_____

_____

_____

_____

Average wind speed = _____ m/s

(3)

(b) The wind turbines are linked to the National Grid by underwater cables.

(i) What is the National Grid?

_____

_____

(1)

(ii) How is the National Grid designed to reduce energy losses during transmission?

_____

_____

_____

(1)

(c) Read this extract from a newspaper.

Power crisis as island basks in sunshine

The population of a small island off the coast of Scotland decided to generate all their electricity from water and wind. However, they did not predict having a long period of warm, dry weather. A combination of low water levels and hardly any wind has drastically reduced the output from the hydroelectric power station and wind turbines.

Explain **one** way in which the islanders could try to ensure that a similar power crisis does **not** happen in the future.

_____

_____

_____

_____

(2)

(Total 7 marks)

Mark schemes

Q1.

(a) thermometer

1

stopclock / stopwatch

accept measuring cylinder

accept top pan balance

1

(b) independent: type of oil

1

dependent: temperature rise in °C

1

(c) wear safety goggles

1

oil not heated directly

accept any reasonable comment about not handling hot apparatus.

1

(d) repeat the experiment

1

and calculate the mean temperature rise

OR

heat the oil for a longer period of time (1)

to get a wider range of temperatures (1)

1

(e) (17 + 17 + 18) / 3 (= 17.33)

1

temperature rise = 17 (°C)

1

*accept 17 (°C) with no working shown for **2** marks*

*allow 17.33 with no working shown for **1** mark*

(f) E = 0.025 × 1800 × 20 (J)

1

E = 900 (J)

1

*allow 900 without working shown for the **2** calculation marks*

Joule

1

[13]

Q2.

(a) **Level 3 (5–6 marks):**

A clear, logical explanation containing accurate ideas presented in the correct order with links between ideas.

Level 2 (3–4 marks):
Key ideas presented with some linked together to form a partial explanation.

Level 1 (1–2 marks):
Fragmented ideas, some may be relevant, insufficient links to form an explanation.

0 marks:
No relevant content.

Indicative content

- current in the wire causes heating
- increases temperature of the metal wires / ice

Solid

- arrangement of particles is regular
- particles vibrate about a fixed position

Melting

- internal energy of the ice increases, increasing the temperature to melting point
- so (as the temperature increases) particles vibrate faster
- eventually particles vibrate fast enough to break free from the (strong) bonds
- therefore the arrangement of particles becomes irregular

Liquid

- arrangement of particles is irregular
- particles movement (translational) is random

6

(b) The current in the heating element

1

The mass of ice

1

(c) latent heat of fusion

1

45 / 120 = 0.375

1

0.38

*allow 0.38 with no working shown for **2** marks*
*allow 0.375 with no working shown for **1** mark*

1

[11]

Q3.

(a) the store of chemical energy (in the battery) decreases

1

the internal energy of the surrounding air increases.

1

accept description of energy becoming less usefully stored

*for **2** marks*

(b) kinetic energy = ½ mass × velocity^2

1

(c) $E_K = ½ \times 0.8 \times 12^2$

1

$E_K = 57.6$ (J)

1

*allow 57.6 (J) without working shown for **2** marks*

(d) lower proportion of wasted energy

accept less energy is wasted

1

higher proportion of energy is converted into <u>kinetic</u> energy

accept more kinetic energy

1

(e) **Level 2 (3–4 marks):**
A relevant and coherent argument which demonstrates processing and numerical analysis of the information presented and draw a conclusion which is logically consistent with the reasoning and refers to payback time for the vehicles.

Level 1 (1–2 marks):
Simple comparisons are made which demonstrate a basic ability to numerically analyse
the information presented. The conclusion, if present, may not be consistent with the calculations.

0 marks:
No relevant content

Indicative content
- The electric car costs £12 000 more to buy
- Running cost of electric car = £3 000
- Running cost of petrol engine car = £24 000
- Total cost of electric car = £30 000
- Total cost of petrol engine car = £39 000
- The electric car cost £1 750 less to run each year
- The electric car will save £9 000
- Additional cost is covered in 6.9 years
- So the electric car will be cheaper over the 12 year lifetime

or

Electric
27000 / 12 = 2250
Annual cost = 2250 + 250 = 2500

Petrol
15000 / 12 = 1250
Annual cost = 1250 + 2000 = 3250

So electric is £750 cheaper per year

4

[11]

Q4.

(a) water boils at the same temperature each time

1

control starting temp by allowing enough time for water and kettle to reach room temperature

1

(b) uncertainty = (302 – 298) / 2

1

uncertainty = ± 2 (s)

ignore missing ±

1

(c) (Energy transferred = Power × time)

E = 2.20 × 300

1

E = 660 (kJ)

1

*allow 660 (kJ) without working shown for **2** marks*

*allow answer calculated using incorrect value for t (298 or 302) for **1** mark*

(d) (mass × change in temperature) / mass

*allow **1** mark for any correct pair of values from the table*

1

eg 20 / 0.25

80 (°C)

1

*allow 80 (°C) without working shown for **2** marks*

(e) four points plotted correctly

*allow **1** mark for three correctly plotted points*

2

ecf their 5.3

allow ± 1mm

accurate line drawn

line should be straight and drawn with a ruler

1

line must not go through the origin

(f) values read correctly from graph

1

correct conversion into J

1

correct use of $\Delta y / \Delta x$

1

value in range 4200 – 4800

1

*allow value in range 4200 – 4800 without working shown for **4** marks*

(g) some of the energy supplied does not raise the temperature of the water

some of the energy is wasted is insufficient

1

(h) (the power of the kettle may not be 2.2kW)

(by measuring the power) the student can accurately calculate the amount of energy supplied to each mass of water

1

[17]

Q5.

(a) **Level 3 (5–6 marks):**
A full, detailed and coherent plan covering all the major steps is provided, which outlines what needs to be measured to calculate specific heat capacity. The steps are set out
in a logical manner that could be followed by another person to calculate the specific heat capacity.

Level 2 (3–4 marks):
The substantive content of a plan is present but may be missing some steps. The plan
may not be in a completely logical sequence but leads towards the calculation of the specific heat capacity.

Level 1 (1–2 marks):
Simple statements relating to relevant apparatus or steps are made but they may not be
in a logical order. The plan would not allow another person to calculate specific heat capacity.

0 marks:
No relevant content.

Indicative content

- measure the mass of metal
- correct use of balance
- description of how work is done or energy transferred to metal
  eg electrical work, mechanical work (eg dropping lead shot)
- how energy transfer or work done is measured
  eg electrical using joulemeter, mechanical decrease in potential energy store of falling lead shot
- equate work done / energy transferred = increase in thermal energy store of the
  metal
- calculate specific heat capacity

6

(b) 4 600 = 1 × 657 × temperature change

1

temperature change = 4 600 / 657

1

= 7 (°C)

*allow 7 with no working shown for **3** marks*

1

(c) Type of material

1

(d) heat loss

1

then any **one** from:

- turned off the power supply too early
- incorrectly measured mass of material
- incorrectly measured temperature
- incorrectly read the change in thermal energy

1

(e) would give a more accurate value **or** the calculated specific heat capacity will be smaller

1

because the bubble wrap insulates the material **or** prevents heat loss

1

[14]

Q6.

(a) gravity (of moon and sun)

1

(b) any **two** from:

__1__ mark for statement, __1__ mark for correctly linked reason

- tidal energy is renewable (1)
- so won't run out like fossil fuels (1)

or

- doesn't emit carbon dioxide
- so won't contribute to global warming / climate change

or

- doesn't emit oxides of sulfur or nitrogen
- so doesn't cause acid rain

or

- doesn't use fossil fuels
- so less impact on environment of extraction / transport

or

- doesn't produce particulates
- so less effect on health / environment

Max. 4

(c) coal consumption per year = 29.25 × 1000 × 6 million = 175 500 000 000 MJ

1

1 hectare of willow will produce 9 × 13 × 1000 = 117 000 MJ per year

1

so need 175 500 000 000 ÷ 117 000 = 1 500 000 (hectares)

1

*allow 1 500 000 with no working shown for **3** marks*

(d) although has higher direct emissions than other fuels

1

it has much lower lifetime emissions

1

[10]

Q7.

(a) 600 kg = 5880 N

1

power = $\frac{5880 \times 35}{45}$

1

= 4573.3 (W)

*this step without the previous steps stated gains **3** marks*

1

% Eff. = $\frac{4573.3}{8000} \times 100$

1

= 57.17 (%)

*allow 57.17 with no working shown for **5** marks*

1

(b) gpe = 600 × 9.8 × 35

1

= 205 800

1

gpe = KE = ½ m v^2

1

$v = \sqrt{\frac{2 \times kE}{m}}$

1

$= \sqrt{\frac{411\,600}{600}}$

1

= 26.2 (m / s)

*allow 26.2 with no working shown for **6** marks*

1

[11]

Q8.

(a) (i) 150

1

(ii) transferred to the surroundings by heating

reference to sound negates mark

1

(iii) 0.75

*450 / 600 gains **1** mark*
*accept 75% for **2** marks*
*maximum of **1** mark awarded if a unit is given*

2

(iv) 20 (s)

*correct answer with or without working gains **2** marks*
*correct substitution of 600 / 30 gains **1** mark*

2

(b) (i) to avoid bias

1

(ii) use less power and last longer

1

1 LED costs £16, 40 filament bulbs cost £80

or

filament costs (5 times) more in energy consumption

1

(iii) any **one** from:

- availability of bulbs
- colour output
- temperature of bulb surface

1

[10]

Q9.

(a) (i) electrical

correct order only

1

kinetic

1

sound

1

(ii) transferred into surroundings / atmosphere

accept warms the surroundings
allow released into the environment
becomes heat or sound is insufficient

1

(b) 0.7 / 70 %

*an answer of 70 without % or with the wrong unit **or** 0.7 with a unit gains **1** mark*

2

[6]

Q10.

(a) (i) <u>water</u>

1

heated

accept boiled or turned to steam

*do **not** accept evaporated*

1

<u>generator</u>

1

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

1

(b) falling water

1

[5]

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 × 6

or

2 000 000 × 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) water moves (from a higher level to a lower level)

1

transferring GPE to KE

1

rotating a turbine to turn a generator
accept driving or turning or spinning for rotating
moving is insufficient

1

transferring KE to electrical energy
*transferring GPE to electrical energy gains **1** mark of the **2** marks available for energy transfers*

1

(b) (TVs in stand-by) use electricity
accept power / energy

1

generating electricity (from fossil fuels) produces CO_2
accept greenhouse gas
accept sulfur dioxide

1

(CO_2) contributes to global warming
accept climate change for global warming

accept greenhouse effect if CO_2 given
accept acid rain if linked to sulfur dioxide

1

(c) a factor other than scientific is given, eg economic, political or legal
personal choice is insufficient

1

[8]

Q13.

(a) (i) 5.88 (watts)
*an answer of 5.9 scores **2** marks*
*allow **1** mark for correct substitution ie*
$0.42 = \frac{\text{power out}}{14}$
*allow **1** mark for an answer of 0.0588 or 0.059*

2

(ii) 8.12
allow 14 – their (a)(i) correctly calculated

1

(b) (i) input power / energy would be (much) less (reducing cost of running)
accept the converse
electricity is insufficient

1

(also) produce less waste energy / power
accept 'heat' for waste energy

1

(as the waste energy / power) increases temperature of the cabinet

1

so cooler on for less time

1

(ii) line graph
need to get both parts correct
accept scattergram or scatter graph

both variables are continuous
allow the data is continuous

1

(c) number of bulbs used-halogen=24 (LED=1)

1

total cost of LED = £30 + £67.20 = £97.20
accept a comparison of buying costs of halogen £36 and LED £30

1

total cost of halogen= 24 x £1.50 + 24 x £16.00 = £420
or
buying cost of halogen is £36 **and** operating cost is £384
accept a comparison of operating costs of halogen £384 and

LED £67.20

*allow for **3** marks the difference in total cost is £322.80 if the number 24 has not been credited*

1

statement based on correct calculations that overall LED is cheaper

*must be **both** buying **and** operating costs*

an alternative way of answering is in terms of cost per hour:

buying cost per hour for LED $\left(\frac{£30.00}{48000}\right)$ = 0.0625p/£0.000625

buying cost per hour for halogen = $\left(\frac{£1.50}{2000}\right)$ = 0.075p/£0.00075

*a calculation of both buying costs scores **1** mark*

operating cost per hour for LED = $\left(\frac{£67.20}{48000}\right)$ = 0.14p/£0.0014

operating cost per hour for halogen= $\left(\frac{£16.00}{2000}\right)$ = 0.8p/£0.008

*a calculation of both operating costs scores **1** mark*

all calculations show a correct unit

***all** units correct scores **1** mark*

statement based on correct calculations of **both** buying **and** operating costs, that overall LED is cheaper

*correct statement scores **1** mark*

1

[12]

Q14.

(a) water heated by radiation (from the Sun)

accept IR / energy for radiation

1

water used to heat buildings / provide hot water

*allow for **1** mark heat from the Sun heats water if no other marks given*

*references to photovoltaic cells / electricity scores **0** marks*

1

(b) 2 (minutes)

$1.4 \times 10^3 = \frac{168 \times 10^3}{t}$

*gains **1** mark*

*calculation of time of 120 (seconds) scores **2** marks*

3

(c) (i) 150 (kWh)

1

(ii) £60(.00) or 6000 (p)

*an answer of £6000 gains **1** mark*

*allow **1** mark for 150 × 0.4(0) 150 × 40*

*allow ecf from **(c)(i)***

2

(iii) 25 (years)

an answer of 6000 / 240
or
*6000 / their **(c)(ii)** × 4*
*gains **2** marks*
an answer of 6000 / 60
or
*6000 / their **(c)(ii)** gains **1** mark, ignore any other multiplier of **(c)(ii)***

3

(iv) any **one** from:

- will get £240 per year
  *accept value consistent with calculated value in **(c)(iii)***
- amount of light is constant throughout the year
- price per unit stays the same
- condition of cells does not deteriorate

1

(d) any **one** from:

- angle of tilt of cells
- cloud cover
- season / shade by trees
- amount of dirt

1

[13]

Q15.

(a) (i) 70

accept ± half a square
(69.8 to 70.2)

1

(ii) 15

*accept 14.6 to 15.4 for **2** marks*
*allow for **1** mark 70 − 55*
ecf from (b)(i) ± half a square

2

(iii) C

1

biggest drop in temperature during a given time
accept it has the steepest gradient this is a dependent

1

(iv) starting at 70 °C and below graph for C
must be a curve up to at least 8 minutes

1

(v) because 20 °C is room temperature
accept same temperature as surroundings

1

(b) (i) 6720

*correct answer with or without working gains **3** marks*
*6 720 000 gains **2** marks*
*correct substitution of E = 0.2 × 4200 × 8 gains **2** marks*
*correct substitution of E = 200 × 4200 × 8 gains **1** mark*

3

(ii) the fastest particles have enough energy

accept molecules for particles

1

to escape from the surface of the water

1

therefore the mean energy of the remaining particles decreases

accept speed for energy

1

the lower the mean energy of particles the lower the temperature (of the water)

accept speed for energy

1

[14]

Q16.

(a) (i) 77

1

(ii) Oil

1

(b) water

accept H_2O

1

(c) Carbon dioxide causes global warming

1

[4]

Q17.

(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

<u>wind</u> speed / strength varies
*accept <u>wind</u> is **not** constant / reliable*

1

[6]

Q18.

(a) (i) temperature (increase) and time switched on are <u>directly</u> <u>proportional</u>
accept the idea of equal increases in time giving equal increases in temperature
answers such as:
- *as time increases, temperature increases*
- *positive correlation*
- *linear relationship*
- *temperature and time are proportional*

*score **1** mark*

2

(ii) any **one** from:
"it" refers to the metal block

- energy transfer (from the block) to the surroundings
  accept lost for transfer
  accept air for surroundings
- (some) energy used to warm the heater / thermometer (itself)

accept takes time for heater to warm up

- (metal) block is not insulated

1

(iii) 15 000

*allow **1** mark for correct substitution, ie 50 × 300 provided no subsequent step shown*

2

(b) lead

reason only scores if lead is chosen

1

needs least energy to raise temperature by 1°C

accept needs less energy to heat it (by the same amount)
lowest specific heat capacity is insufficient

1

[7]

Q19.

(a) conduction

1

(b) (i) there is a bigger temperature difference between the water and the surrounding air

accept the water is hottest / hotter

1

so the transfer of energy (from hot water) is faster

accept heat for energy
ignore temperature falls the fastest

1

(ii) 120

*allow **1** mark for converting kJ to J correctly, ie 4 032 000*

or

correctly calculating temperature fall as 8°C

or

allow **2** marks for correct substitution, ie 4 032 000 = m × 4200 × 8

answers of 0.12, 19.2 **or** 16.6 gain **2** marks

answers of 0.019 **or** 0.017 gain **1** mark

3

(iii) water stays hot for longer

1

so heater is on for less time

accept so less energy needed to heat water

1

so cost of the jacket is soon recovered from) lower energy costs / bills

accept short payback time

1

[9]

Q20.

(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 CO_2 / SO_2 / 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)

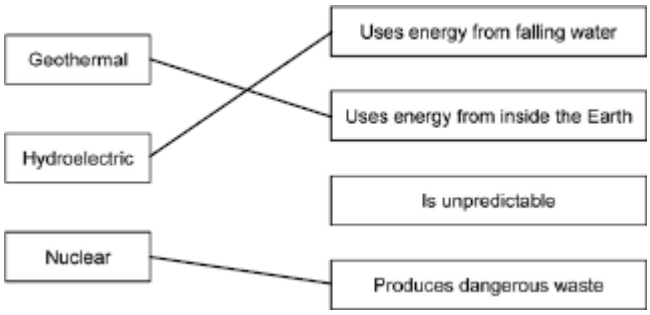
  accept electricity for energy

- more people becoming environmentally aware

1

[7]

Q21.



*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]

Q22.

(a) electrical

1

chemical

1

light

1

(b) 25% **or** 0.25

*allow **1** mark for correct substitution, ie 50 ÷ 200 provided no subsequent step shown*

or

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

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

2

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

1

[6]

Q23.

(a) any **three** from:

- gas can be switched on (and off) quickly but nuclear cannot

  gas has a short start-up time alone is insufficient

- gas can be used to meet surges in demand

  accept specific times from graph, anything from 1700 to 2200

- gas can contribute to / meet the base load

- nuclear provides base load

  or

  nuclear is used to generate all of the time

3

(b) Marks awarded for this answer will be determined by the Quality of Written

Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a brief description of one advantage **or** disadvantage of using either biogas or wind
or
makes a conclusion with a reason.

Level 2 (3-4 marks)
There is a description of some advantages **and / or** disadvantages for biogas **and / or** wind
or
there is a direct comparison between the two systems **and** at least one advantage / disadvantage
or
a detailed evaluation of one system only with a conclusion.

Level 3 (5-6 marks)
There is a clear and detailed comparison of the two systems.

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

Examples of the points made in the response
extra information

Biogas

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

Wind turbine

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

6

[9]

Q24.

(a) (i) 5(.0)

1

(ii) 35 **or** their (a)(i) × 7 correctly calculated
*allow **1** mark for correct substitution, ie 5 **or** their (a)(i) × 7 provided no subsequent step shown*

2

(iii) 525(p)
or
(£) 5.25
or
their (a)(ii) × 15 correctly calculated
if unit p or £ given they must be consistent with the numerical answer

1

(iv) decreases

1

temperature difference (between inside and outside) decreases
accept gradient (of line) decreases
*do **not** accept temperature (inside) decreases*
*do **not** accept graph goes down*

1

(b) air (bubbles are) trapped (in the foam)
*do **not** accept air traps heat*
foam has air pockets is insufficient

1

(and so the) air cannot circulate / move / form convection current

air is a good insulator is insufficient
no convection current is insufficient
answers in terms of warm air from the room being trapped are incorrect and score no marks

1

[8]

Q25.

(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]

Q26.

(a) iron

1

hairdryer

1

kettle

1

answers can be in any order

(b) (i) **Y**

1

(ii) bar drawn with any height greater than **Y**

ignore width of bar

1

(c) (bigger volume) takes more time (to boil)

accept explanation using data from graph

1

(so) more energy transferred

*do **not** accept electricity for energy*

1

(and) this costs more money

ignore reference to cost of water

wasting more money because heating more water than needed is insufficient

1

[8]

Q27.

(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]

Q28.

(a) light

correct order only

1

electrical

1

(b) 0.2 or 1/5

accept 20% for both marks

*allow **1** mark for correct substitution ie* $\frac{35\,000}{175\,000}$

*answers of 0.2% **or** 20 gain **1** mark only*

2

(c) any **one** from:

- produces no (pollutant) gases
  or
  no greenhouse gases

  accept named gas

  accept no <u>air</u> pollution
  *do **not** accept no pollution*

  accept less global warming

  accept harmful for pollutant
  accept produces no carbon
  *do **not** accept environmentally friendly*

- produces no / less noise

- less demand for fuels

  accept any other sensible environmental advantage

1

[5]

Q29.

(a) (i) kinetic

*do **not** accept movement*

1

(ii) thermal sound

accept heat for thermal
*do **not** accept noise for sound*

***both** answers required in either order*

1

(b) transferred to surroundings / surrounding molecules / atmosphere

'it escapes' is insufficient

or
becomes dissipated / spread out

accept warms the surroundings

accept degraded / diluted

accept a correct description for surroundings eg to the washing machine

*do **not** accept transformed into heat on its own*

1

(c) (i) 3 (.0 p)

*allow **1** mark for correct substitution of correct values ie 0.2 x 15*

*allow **1** mark for calculating cost at 40°C (16.5p)*

or

cost at 30°C (13.5p)

2

(ii) any **two** from:

- less electricity needed
  ignore answers in terms of the washing machine releasing less energy
  an answer in terms of the washing machine releasing CO_2 negates mark
  *do **not** accept less energy is produced*
- fewer power stations needed
- less fuel is <u>burned</u>
  accept a correctly named fuel
  *do **not** accept less fuel is needed*

2

[7]

Q30.

(a) (i) replaced faster than it is used
accept replaced as quick as it is used
accept it will never run out
*do **not** accept can be used again*

1

(ii) any **two** from:
***two** sources required for the mark*

- wind
- waves
- tides
- fall of water
  *do **not** accept water / oceans*
  accept hydroelectric
- biofuel
  accept a named biofuel eg wood
- geothermal

1

(b) (i) any **two** from:

- increases from 20° to 30°
- reaches maximum value at 30°
- then decreases from 30°
- same pattern for each month
  *accept peaks at 30° for **both** marks*
  *accept goes up then down for **1** mark*
  ignore it's always the lowest at 50°

2

(ii) 648

*an answer of 129.6 gains **2** marks*
*allow **1** mark for using 720 value only from table*
*allow **2** marks for answers 639, 612, 576, 618(.75)*
*allow **1** mark for answers 127.8, 122.4, 115.2, 123.75*

3

(c) (i) (sometimes) electricity demand may be greater than supply (of electricity from the system)
accept cloudy weather, night time affects supply

or

can sell (excess) electricity (to the National Grid)

1

(ii) decreases the current
accept increases the voltage

1

reducing energy loss (along cables)
accept less heat / thermal energy lost / produced

1

[10]

Q31.

(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 CO_2 / 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]

Q32.

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

1

reducing energy losses (in cables)

accept heat for energy

*do **not** accept electricity for energy*

*do **not** accept no energy loss*

accept wires do not get as hot

or
increases efficiency of (electricity / energy) transmission

ignore reference to travel faster

1

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

0 marks
No relevant content

Level 1 (1-2 marks)
There is a brief description of one advantage or disadvantage of using either overhead or underground cables.

Level 2 (3-4 marks)
There is a description of some of the advantages **and / or** disadvantages for both overhead and underground cables, with a minimum of three points made. There must be at least **one** point for each type of cable.

Level 3 (5-6 marks)
There is a clear and detailed description of the advantages and disadvantages of overhead **and** underground cables, with a minimum of five points made. At least one advantage and one disadvantage for each type of cable.

examples of the points made in the response

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

eg

overhead cables are easy to repair = 1 mark

overhead cables are easier to repair = 1 mark

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

Overhead
Advantages

- (relatively) quick / easy to repair / maintain / access
  easy to install is insufficient
  *do **not** accept easy to spot / see a fault*

- less expensive to install / repair / maintain
  less expensive is insufficient

- cables cooled by the air
  accept thermal energy / heat removed by the air

- air acts as electrical insulator
  accept there is no need for electrical insulation (around the cables)

- can use thinner cables
  difficult to reach is insufficient
  land beneath cables can still be used is insufficient

Disadvantages

- spoil the landscape

- greater risk of (fatal) electric shock

- damaged / affected by (severe) weather
  accept specific examples eg high winds, ice
  more maintenance is insufficient

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

Underground
Advantages

- cannot be seen

- no hazard to aircraft / helicopters

- unlikely to be / not damaged / affected by (severe) weather
  less maintenance is insufficient

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

Disadvantages

- repairs take longer / are more expensive
  accept harder to repair / maintain
  have to dig up for repairs is insufficient

- (more) difficult to access (cables)
  hard to locate (cables) is insufficient

faults hard to find is insufficient

- (very) expensive to install
- thicker cables required
- need cooling systems
- need layers of electrical insulation
- land disruption (to lay cables)
  accept damage to environment / habitat(s)
  or
  cannot use land either side of cable path
  accept restricted land use

6

(c) examples of acceptable responses:
*allow **1** mark for each correct point*

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

2

(d) ethical

1

[11]

Q33.

(a) (i) $$efficiency = \frac{useful\ energy\ out\ (\times 100\%)}{total\ energy\ in}$$

1.6 (W)

*allow **1** mark for correct substitution ie* $0.2 / \frac{20}{100} = \frac{output}{8}$

2

(ii) $$efficiency = \frac{useful\ energy\ out\ (\times 100\%)}{total\ energy\ in}$$

32 (%) / 0.32
or

their (a)(i) ÷ 5 correctly calculated

ignore any units

1

(b) (i) any **two** from:

- comparison over same period of time of relative numbers of bulbs required eg over 50 000 hours 5 CFL's required to 1 LED

  accept an LED lasts 5 times longer

- link number of bulbs to cost eg 5 CFL's cheaper than 1 LED

  an answer in terms of over a period of 50 000 hours CFLs cost £15.50 (to buy), LED costs £29.85 (to buy) so CFLs are cheaper scores both marks

  an answer in terms of the cost per hour (of lifetime) being cheaper for CFL scores 1 mark if then correctly calculated scores both marks

- over the same period of time LEDs cost less to operate (than CFLs)

2

(ii) any **one** from:

- price of LED bulbs will drop

  *do **not** accept they become cheaper*

- less electricity needs to be generated

  accept we will use less electricity

- less CO_2 produced

- fewer chips needed (for each LED bulb)

- fewer bulbs required (for same brightness / light)

- less energy wasted

  *do **not** accept electricity for energy*

1

[6]

Q34.

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

- produces no (air / atmospheric) pollution

  accept named pollutant eg CO_2

  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]

Q35.

(a) 9

*allow **2** marks for power = 1400 (kW)*

*if a subsequent calculation is shown award **1** mark only*

or

*allow **1** mark for correct substitution and transformation*

power = $\frac{5600}{4}$

*allow **1** mark for using a clearly incorrect value for power to read a corresponding correct value from the graph*

3

(b) (i) system of cables and transformers

both required for the mark

ignore reference to pylons

inclusion of power stations / consumers negates the mark

wire(s) is insufficient

1

(ii) (uses step-up transformer to) increase pd / voltage

accept (transfers energy / electricity at) high voltage

or

(uses step-up transformer to) reduce current

accept (transfers energy / electricity at) low current

ignore correct references to step-down transformers

1

(c) build a power station that uses a non-renewable fuel or biofuel

accept a named fuel

eg coal or wood

or

buy (lots of) petrol / diesel generators

1

stockpile supplies of the fuel

accept fuel does not rely on the weather

or

fuel provides a reliable source of energy

accept as an alternative answer idea of linking with the National Grid (1)

and taking power from that when demand exceeds supply (1)

or

when other methods fail

or

when it is needed

answers in terms of using other forms of renewables is insufficient

1

[7]